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AMERICAN CHILDHOOD FROM A MEDICAL STANDPOINT.

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A GOOD deal has been said and written about our national temperament and physique, and it is doubtless true that the various stocks of the Old World, transplanted to our soil and subjected to new conditions of life, have felt the molding influences of changed surroundings. The human organism is preeminent in its marvelous adaptability to the most varied conditions of life. It has complex mechanisms which convey, store up, modify, and discharge the showers of impressions constantly received through nerve-endings in the skin, membranes, and tissues, as well as through the organs of special sense. We recognize that different individuals and races react somewhat differently to stimuli; they have inherited or acquired special characteristics of mind and body, largely due to habits evoked by special surroundings and ingrained by frequent repetition, whether in themselves or in their ancestors. If inherited bias counts for very much in molding the organism, this is equally true of impressions frequently repeated, or the steady push of constantly acting, though it may be scarcely noticed, forces.

Conspicuous factors in modern life are the extreme specialization of pursuits and occupations tending to narrow and restrict experience, and the herding together of dense masses of population in large cities, toward which the more venturesome and ambitious individuals tend to gravitate, and where larger opportunities are provided, only at the cost of more strenuous competition, and in many respects less favorable hygienic conditions. Success is paid for, both directly and remotely, in pounds of flesh.

It has been claimed that the strongest blood can not endure continuous city life for more than three generations, but must be kept alive by the infusion of country blood or by the return in some degree to country life. Thus our large cities are a kind of biological furnace, which in the end consumes the lives supplied to it, in order to obtain the product in trade, science, and art which we so much admire. If, in the course of this fiery ordeal, the individual receives a keener temper or a finer polish, he may not become stronger physically or better balanced mentally, and thousands, unable to endure the strain, are cast off or incapacitated, while hundreds of thousands are not able to transmit to their children the physical endowment which they themselves originally possessed. It is the purpose of this paper to study the physiological tendency of the forces to which many American children are subjected, especially in our largest cities, where the logical effects of characteristic habits or traits are most strikingly evident. Physicians know that city children get too little light and air, do not take enough of the right kind of exercise, are often overfed or underfed, are pushed or pampered too much in their studies, and especially in their emotions, and frequently shorten their childhood to become little men and women before emerging from pinafores and knickerbockers. Such criticisms have been frquently passed, and that they are not unfounded we can all testify.

We instinctively recognize more truth than jest in Henry James's description of the little girl who rushed into the hotel parlor on roller skates, shouting: "Get out of the way!" and we have at once a clear mental picture of her pale, eager face, slim figure, shallow chest, attenuated limbs, and weak ankles; so inevitably does the simple exclamation suggest a correlated and too familiar physique. Healthy immigrants, or country people coming to the city to live, usually lose their fresh, ruddy color in a few months, and their firm flesh becomes flabby, though city people are, as a rule, better walkers and can stand more of certain kinds of exertion. We may take the physique of the little girl on roller skates as a type of frequent occurrence. In children of the corresponding class the feelings may be intense or sluggish, but in either case betray the lack of proper balance and correct discipline. There is a precocity in knowledge of people and social relations, darkest ignorance with regard to most natural objects and processes. The mind and body may be restlessly active or listless and indolent; in either case the fundamental qualities of docility and poise are lacking; there may be much development on the æsthetic side, or much in comparison with the neglect of the practical. The city child is handicapped from the start. He is usually produced with difficulty from overtaxed and under-

nourished, not necessarily underfed, stock rather than from the superabundant vitality of robust natures. The cultured mother rarely has sufficient vigor to nurse her infant, and it is brought up on some substitute, which at the best is but a makeshift. Whatever modern life and culture may have done for our women, they hardly seem, in their extreme forms, to have prepared them for the intelligent care of their offspring, whose arrival is often regarded with pathetic helplessness. There is, however, enough of New England's "inflamed moral sense" in our midst to furnish our women with a fair share of conscience, so that their errors are as apt to be due to over-solicitude as the reverse. Take the matter of clothing, for example: this is frequently piled on till the hapless youngster presents the appearance of a bale of millinery, impeding movements, keeping the child overheated, and forming a conspicuous part of the hot-house life which the child is henceforth to lead. Literally "hot-house," for there is something in our houses, their heating apparatus, or the habits of the people, which keeps our residences at a tropical heat during the cold season. I am inclined to think it is partly a result of our high-pressure life. A tired brain and exhausted nerves crave warmth; and indolent or sedentary habits do not predispose one to bear a bracing temperature. Be that as it may, the little ones grow up in an atmosphere of steady, relaxing warmth, and the continual endeavor is to protect them from anything approaching cold. Their baths are usually hot, and there is a noticeable absence of that skin culture which comes naturally to country children, living out of doors, sleeping in a cold room, skating or snow-balling in winter, and swimming in the neighboring pond in summer. It seems that the whole tendency of city life is toward "making it easy," physically, for the individual by the elimination of all except the simplest demands on the organism, forgetting that our powers are developed by their cultivation, and inevitably deteriorate with disuse. Our life is so artificial that we require gymnasiums, field-sports, and outings to keep a decent physical equilibrium, and we ought in addition to give particular attention to vascular gymnastics and to the culture and development of the unstriped muscular fibers, which play so fundamental a part in vital economy, by placing more dependence on their adjustive and resisting powers, through a systematic and judicious exposure of the skin to cold water, cold air, and the vicissitudes of weather. As to the diet of children after the nursing age, it is likely that our city children fare better than many of their country cousins. There is probably no country in the world where there is such an attractive variety of cheap and wholesome food of all classes, meats, cereals, vegetables and fruit, as in our own. The general habit of fruit-eating, which seems to

be growing, is, I believe, salutary, and to be encouraged. Good fruit is practically within the reach of all at all seasons, and we are probably the only nation out of the tropics where fresh fruit is a staple article of diet every day in the year. The temptation and tendency in the diet of children is toward an over-indulgence in animal and saccharine food, and in elaborate made dishes; and the practice of allowing children to eat at the same hours with their elders, and substantially the same things, is liable to result in a trying regimen for the child.

In regard to fresh air, the youthful citizen of the metropolis is not likely to get too much of it indoors, and the few hours a day spent on the sidewalk or in a perambulator are a sorry substitute for rolling over the grass or tumbling about the door-yard. When the child is a few years older the difficulty is increased. Young children are in constant motion, and this is Nature's method of educating the muscles and nerve-centers in the selection and development of those complicated associated movements and correlated reactions which finally form the automatic groundwork of our life. We are brought by these means into contact with all kinds of natural objects, in order that we may become aware of their attributes and react promptly and advantageously to their stimulation. The city child, however, instead of soil with its diversified coverings, has hard and mostly level floors or pavements; instead of grateful greenish, bluish, or brownish tints, the patchwork surface of our houses and streets; and instead of restful silence or simple and harmonious sounds, the irritating jar of complicated, intense, and discordant noises. We may compare the conditions to which the city child is subjected to the life of a trainman, who is hampered in his movements and at the same time subjected to storms of auditory, visual, and other impressions in unending succession.

I recently had occasion to compare the development of a typical city boy of eighteen months with that of a little girl of fifteen months brought up in a small inland town. The boy was the only child of cultivated city parents; the little girl was the youngest of several children, and her parents were plain trades-people. Though the girl had congenital club-foot and had never walked, she had remarkably good control over the movements of the arms, legs, head, and trunk. She placed her finger on or grasped an object with exactness, threw a ball with force and precision, and hitched herself about the floor with great dexterity and rapidity. All her movements were well planned and well executed, and many of them complicated, such as putting a tin cup upon the end of a stick and shaking it without letting it fall off. She could speak only a few words, but had a great deal to say in her baby language. The expression on her face was placid and contented,

though often animated, and she would sit for hours on the floor and amuse herself. She rarely cried, took her daily naps as a matter of course, and slept quietly all night. Teething did not annoy her, and, in spite of irregular feeding, her digestion was good.

The little boy refused to creep or sit on the floor at all, but ran about incessantly. His movements, except locomotion, were far less complicated and precise than those of his playmate. He could not put the cup on the stick, though he tried repeatedly, nor throw a ball nearly so well. He was incessantly and intensely interested in the things he saw, but only fixed his attention on an object for an instant. He had no initiative, and, as he was unable to amuse himself, he was never left alone. He talked a great deal, but not plainly, and understood nearly everything that was said to him; and it pleased him to mimic the little girl's ways and prattle. He was very fond of having the piano played to him, and could always distinguish the tunes he had heard a few times. He was bright and intelligent, and, when feeling well, very good and happy, but was a bad sleeper, and at times cross and fretful; in spite of scrupulous attention to diet, he was a martyr to indigestion, and teething caused him much suffering.

It is noticeable that many city children are thrown more among adults and less with children than is desirable, partly from the custom of relegating a large part of the parental responsibility to a nurse, partly from the small average number of children in a family, and partly from the limiting conditions of city life, which are somewhat unfavorable to real sociability. The chances are that unless a child runs the streets he will see more of two or three or half a dozen adults than of all the rest of the world put together. This is abnormal and unwholesome, as it deprives the child of the kind of mental stimulus and discipline suited to his age, and substitutes something wholly inappropriate and harmful in its tendency. When the school years come, the children have companionship, at least in school hours, but also in many instances an imperfect school hygiene, with its bad air, poor light, cramped positions, and other drawbacks. Dr. C. F. Folsom says of city school children: "Pale faces, languid work, poor appetite, disturbed sleep, headache, and what is vaguely called nervousness, are more common among them than they should be among children of their ages," and speaks of "constitutions weakened during the school years, instead of strengthened, as they should be."

On account of lack of familiarity with country life, many city children of the lower school grades, as shown by President G. Stanley Hall, have the most extraordinarily distorted ideas about the commonest natural objects and phenomena, and much of this mass of misinformation remains in adult life. On the other hand,

they may be keen judges of character and conduct and be well able to hold their own in a bargain or an argument. Of a class of about thirty girls from eight to thirteen years of age living east of the Bowery, only three had been in Central Park and only four had ever visited the country. When taken to Central Park by a friend, they first asked if they might step on the grass, and then, with the natural instinct of young animals, lay down and rolled on it.

As already remarked, it is natural for the young child to move about and change its attitude almost incessantly; in the words of Sir William Jenner, "it joys to exercise every muscle"; and it is equally true that its eyes, attention, and mind should never be directed continuously at one object for very long. A child loves to glance at this object, pick up that, reach out for a third, not restlessly but wonderingly, caressingly, and joyously, just as a short time before the infant played contentedly with its rattle or its ring, waving it about or putting it into its mouth with endless repetition, but always without studious observation or strain of attention. I am afraid we often injure these small eyes and tender brains by requiring continuous repose of body and fixation of eye and attention on some one object, as is often done in the kindergarten and primary work, at the cost of ocular and nervous strain; and this combined with bad light and general driving may account for much of modern myopia, headache, and nervous troubles. We should advance in the education of muscle, eye, and brain from the general to the particular, and impose no task requiring precision or intense application upon young children. Nature is a good schoolmistress, and her lessons are fundamental ones, no matter how much we may supplement them at school or university. The infant is learning fundamental lessons, in the correlation of muscle, brain, and sense, through the almost incessant activity of his arms and legs—at first without purpose, afterward in reaching, grasping, or trying to move about, and also when it smiles back at its mother or is quieted by her voice; so is the child repeating nursery rhymes or busy with its quiet play or romping games; or the youth with his carpenter's tools, or riding, swimming, or hunting, and learning just as truly, and perhaps more truly, than the student burning midnight oil over Greek and calculus. Nature is never systematic in the school sense; and, however much we may systematize, we must at the same time cultivate our powers and round out our individuality by keeping in touch with so much of Nature and man as lies within our horizon in a restful, informal way. If a man is to develop into something more than a machine or formula, he should be encouraged from childhood to bring all his powers into relation with his environment and to seek a wide range of adjustments

between himself and the outer world, beyond the tread-mill round of special or formal pursuits which necessarily occupy much of his attention. Many fail to appreciate the importance of this indispensable natural culture, and endeavor to supplant the spontaneous by the formal. I know of a little girl whose interest in flowers was destroyed by an attempt to teach her technical botany at too early an age, forgetting that it means more to love flowers than to know botany. In another case the attempt was made to substitute history for a boy's ordinary reading, with the result of spoiling the boy. On reaching manhood his favorite author was E. P. Roe.

Correct mental reactions must be based upon correct physical reactions, which are naturally evoked by a free open-air life. As Lowell puts it: "The driving-wheels of all-powerful Nature are in the back of the head. . . . But it is ill with a nation when the cerebrum sucks the cerebellum dry, for it can not live by intellect alone. The broad foreheads always carry the day at last, but only when they are based on or buttressed with massive hindheads. . . . Moreover, brain is always to be bought, but passion never comes to market."

The city boy's supplemental training at school is far from perfect, but his fundamental, unstudied training by contact with Nature in the free use of his proper activities is wofully deficient. If restricted to the city, he can hardly become familiar with any natural objects but a few animals, building materials, and foodstuffs; his notion of such fundamental objects as the sky or horizon must be extremely hazy. His relations with people, or at least with certain individuals, are likely to be too close; he can not escape from them, and is over-stimulated or overpowered. This leads me to speak of family life as we observe it, perhaps the most important factor of all in the child's development, physical as well as mental and moral.

It is sometimes claimed that women are not as good housekeepers and home-makers as formerly, and if this be true it is not altogether their fault. It is not to be denied that the number of families in New York, for instance, is far in excess of the number of homes. The tendency with us is for the mistress of the house to participate less and less in the details of household management, and much of the work is left to hirelings inside and outside of the premises. The desire to diminish some of the difficulties of city housekeeping has caused the wholesale introduction of flats, which are, as a rule, cramped and poorly lighted, and, to say the least, ill adapted for the rearing of children. Rooms in suites have made it possible to dispense with the kitchen and its autocrat, and the disintegration of the home is complete in boarding-houses and hotels. The promiscuity of the tenement is equally

unfavorable to a home atmosphere and home employments. The modest requirement of a small, plain house with light and air on all sides, is beyond the reach of the millionaire. Unless we stop to think, we are apt to forget how high a price we pay for the privilege of much laborious striving and cramped living.

So much has been said about the frivolity, incompetence, or fussiness of American mothers that it will not be amiss to inquire into the characteristics of our fathers of families. With the best intentions in the world the time that a city man can spend with his family is usually very limited, and he is not always in the mood to exert a helpful influence, when he returns at night worn out with business cares, and often prefers the club, lodge, or neighboring corner to his family circle; his wife may see little of him and his children less. It is not a matter of indifference, however, even in regard to health, whether the children enjoy a due proportion of their father's companionship, for that is or should be a vital factor in the children's growth and education, and, whenever they are deprived of it, certain elements of character and mind are almost always absent. Look around among your friends where the children have grown up without a father, and see if your observation does not show that there is some quality of mind or heart, some check or balance wanting, that no one else could supply. I observe that American fathers, whether from the exactions of business or other reasons, do not ordinarily come to my office with their ailing children. The whole matter is often left in the hands of the wife or some relative. Germans are more apt to come than Americans, and Hebrews most of all; and indeed I can not refrain from expressing my admiration of the domestic life of the better class of Jews in New York, which, so far as I have observed it, is in many respects more nearly what it should be than that of any class in our community.

Body and mind grow together; what affects the one must affect the other, so that if the influence of either parent is withdrawn the due proportion or balance is lost and certain physical as well as mental peculiarities in the children are dwarfed or accentuated. The home atmosphere often determines the mental and moral, and consequently the physical tone of the children. I claim distinctly that an atmosphere of frivolity, indolence, self-consciousness, fussiness, discontent, sentimentality, or meanness can not be without serious effects not only on the character but on the physique. Selfishness in any form is not only unattractive, but it is unwholesome; it is a depressant to the system. *Per contra*, high and well-rounded living not only makes sound thinking, but it abbreviates doctors' bills. It is a truism to say that no one has so much to do with the child's acquisition of a healthy moral and physical tone as his parents, but few realize how tremendous a

factor in the evolution of the individual we touch at this point. We need the mother's influence and the father's influence in the family, and also the influence of the children on each other. First children, last children, only children, children of small and large families, all have their special attributes and defects. The child is receiving and adjusting every instant, impressions that will positively determine not only his future career but his bodily structure. Parents and care-takers must see that these impressions are useful and true. The means in the control of the physician are as nothing compared to home influences and conditions in shaping a healthy mind and body. The reactions most frequently evoked will be the dominating ones. As Bacon puts it: "Therefore since Custome is the principle Magistrate of a Man's life; let Men by all Means endeavour to obtain good Customes. Certainly Custome is most perfect when it beginneth in Young Years. This we call Education; which is in effect but an early Custome"; or as another says: "In the conduct of life, habits count for more than maxims, because habit is a living maxim, become flesh and instinct. To reform one's maxims is nothing; it is but to change the title of the book. To learn new habits is everything, for it is to reach the substance of life. Life is but a tissue of habits" (Amiel's Journal, page 7). All of which applies as cogently to the physical as to the mental. "Nothing has ever been invented to take the place of a 'bringing up.'" The home has been compared to the ship-yard where the vessel's construction is slowly and painstakingly elaborated step by step, so that the structure may be able to outride the strains and disintegrating tendencies that are sure to attack it later, just as the growing human organism is built up, under fostering influences, by the gradual incorporation of helpful habits and useful physical reactions. Self-control and transparent honesty in the parent are as essential as obedience and self-reliance in the child. "He that will have a cake of the wheat must tarry in the grinding." The child does not exist who can grow up natural or healthy without a fair share of wholesome neglect and judicious exposure. Few realize the tremendous risk of over-caution and over-attention. A youngster is invariably happier with few and simple playthings than with a multitude of complicated toys. There is no such good fun or good training as making one's self useful, and it is cruelty to deprive the child of this pleasure and stimulus. Let the brain and body be trained through hand, foot, and eye. Dump a load of sand into the back yard and let the children roll in it. Give the boys a carpenter's bench; encourage the girls to do housework. Where possible, let both boy and girl have a little garden-patch, if only a few feet square, and the care of a few plants. A woman in her home, a man in his garden: this seems

to be a fundamental type from which we can not entirely depart without risk to body and mind. The training of the muscular reflexes should go hand in hand with the cultivation of simple, natural, beneficent reactions in the higher planes. Cheerfulness, sincerity, industry, perseverance and unselfishness may be acquired by practice and constant repetition, as much as the art of correct speaking or of playing the piano, and are far more necessary to health. We must have a basis of correct fundamental physical and psychical reactions as a help toward a proper balance between feeling and will, or our subsequent building will rest on a foundation of sand. How often is a physician hampered in his efforts to help some sufferer, because the latter has never acquired the art of obedience, or because he can not tolerate a tongue-depressor, or swallow a pill or any unpalatable mixture, or take milk or some mainstay of diet; or because he can not be left alone, or sleep in the daytime, or wear flannels, or sit still, or bear pain, or use his muscles, or take in certain classes of facts or ideas! These and similar peculiarities, which are a formidable hindrance to the physician, and may be a matter of life or death to the sufferer, can usually be prevented by a little care, or overcome by proper training. They are often the result of carelessness or over-indulgence, or that kind of cowardice which instinctively avoids the disagreeable, instead of facing a difficulty fairly and conquering it.

Another way in which children are injured is by being used as playthings for the amusement of relatives and friends. There is the temptation, well-nigh irresistible, to show them off, if they are bright, or later to push them along in school or society, sacrificing wholesome symmetry to immediate showy effect. This tendency has largely molded our private schools, for girls especially, whose basis is too often sentimentality of some sort; and sentimentality is a form of narrowness, an incapacity for seeing things in their true proportions.

There is one characteristic of our metropolitan life so salient that it can hardly fail to make itself felt even in childhood. I mean the mad chase after the dollar, the cause of much of the killing tension of city life. It is curious to note that the nation that is conspicuous by the absence of this spirit—I mean the Japanese—has probably the best-behaved children in the world, and is the land of happy childhood. A crying baby is to them a curiosity. This straining of powers till they crack, this incessant fiddling at the nerves, is apt to make our city life restless, asymmetrical, and unsatisfactory; the children feel it and show it in their faces, in the sensitive structure of their bodies, and in the affections and diseases to which they are subject. And this nervous tension, as much as our tropical summer climate, has necessitated that peri-

odical return to Nature or summer outing, which is a national habit, and is the one efficient means, if properly used, of combating the disintegrating tendencies of city life.

The children of the poor, in spite of many drawbacks, fare better in some respects than those of the well-to-do. They often respond better to treatment when they are sick; they are at least not deprived of that contact with their fellows and struggle for existence which is absolutely essential to health; whereas the children of the so-called higher classes are too often educated in sensitiveness, and false and hurtful views of life, not always by precept or example, but by force of circumstances. A colleague, who is intimately acquainted with the physical condition of some eight thousand children, taken from the worst classes in New York, who have in the course of several years passed through a public institution under his care, says that they improve so much, after having enjoyed for a few months the ample diet and simple and regular life provided, that their physical condition compares favorably with that of any class of children in New York.

Much of what has been said applies to certain classes in certain restricted localities, and it may be thought that the picture is an exaggerated one, but I maintain that the physique of the children that are now growing up under our eyes is not on the whole satisfactory, and that it is a difficult matter to bring up wholesome, hearty children in New York, for example: if this is true, it is well to recognize the fact. The average conditions both within and without the family seem restricted and unnatural; fortunately, there is a large amount of sturdy stock throughout the land, brought up to individual independence in contact with Nature, and in wholesome home surroundings, upon which we can draw indefinitely.

It is true that the advantages are not all on the side of country life; that the struggle with Nature may be strenuous, and the living narrow and poor, and that on the other hand the conditions of city life may bring a better diet and a better knowledge of personal hygiene. Indeed, it is claimed that during our civil war certain city regiments stood campaigning better than the men from the country, possibly because they better understood how to take care of themselves. All this does not militate against my position that the conditions of country life are, or may be made, more favorable for children.

Just because life in our large centers puts such pressure on men and women do we get such remarkable effects in certain directions. Much of the world's best work is the direct result, but it is usually the effect of such stimulation on broad and healthy natures developed partly or wholly in the country; and ulti-

mately, unless there are considerable interruptions, the individual or the family is stamped out, as is every individual or family which pursues a too restricted, too artificial, or too one-sided career.

SPECIFICS FOR THE CURE OF INEBRIETY.

By T. D. CROTHERS, M. D.

WHEN any great truth begins to receive public recognition it is always first welcomed by the credulous and visionary enthusiast, who surrounds it with the most extravagant expectations. This brings out the charlatan and empiric who studies to turn all such facts and conditions to his own personal profit. In this way the credulity of the one and the charlatanism of the other envelop the truth with a confusion and mystery that often conceal it for a long time. Only the student and the scientist realize that behind this glamour and illusion there is a uniform evolutionary movement along different lines from that suggested to the popular mind.

The growth of truth may be compared to that of plants—first seen in the seed, then the stalk, the shrub, and finally the tree, always following a distinct and fixed line of march through separate periods and stages. The first stage is that of indifference, neglect, and denial. Then follows the credulous period, in which the truth is partially recognized and accepted, with extravagant conceptions, associated with wild empirical efforts to incorporate it into practical life. Finally, the truth is fully understood, studied, and accepted, and becomes a part of the world's great possessions. This is the natural history of every new fact of science and every new discovery concerning the evolution of humanity. Often these stages extend over long periods of time and are unrecognized except by a few persons; or they follow each other rapidly, but always along the same lines.

The dawning truth that the drink evil is a disease, and curable as other diseases are, has passed the first period of neglect, indifference, and denial, and has come to the second stage of partial recognition and acceptance. The same army of the credulous, the enthusiasts, and marvel-hunters are welcoming this fact, and the same wild expectations of its practical possibilities fill the air. This is followed by the same old charlatanism and empiric efforts to make personal profit out of these truths by the use of the same old quackish means and methods.

These efforts are prominent by the same assumption of superior knowledge of discovery of new facts, of new remedies, and new methods, all of which are concealed. Then follow claims of

extraordinary cures under extraordinary conditions, the proof of which depends alone on the statements of the cured.

Then comes the old story of persecution by physicians and scientists, and of posing as martyrs, public benefactors, and pioneer discoverers, with indirect appeals for sympathy from the broad and liberal minded. Back of all this is a pecuniary field actively tilled which yields rich harvests, and altogether it is the same old familiar history of empiricism, which is always to be found on the advancing frontiers of science. Within two years a large number of charlatans have appeared, claiming to have found remedies and specifics for the certain and permanent cure of the drink disease. A great variety of means and drugs are offered, each one claiming to be superior to all others. Recently one of these empiric specific cures has led all the others in boldness and prominence. Starting from an obscure Western village, it has spread out into many branches, all organized and conducted on one general plan, and federated together. Physicians have been enlisted to conduct each branch, companies have been organized, houses hired, and elaborated arrangements made for the work. Special papers have been established to defend its interests, and the pulpit and press have indorsed and freely praised these efforts. Every possible avenue to attract public attention has been industriously cultivated to keep the subject before the people.

Large numbers of persons who claim to be cured have organized into clubs, and display hysterical enthusiasm to prove the reality of their cure and the greatness of the projector.

It is assumed that the inventor of this specific was the first to urge the theory of disease in modern times; also that he has made a great discovery of a new remedy the nature of which he carefully conceals from the rest of the world. The most wonderful and complete cures of the most incurable cases are accomplished in two or three weeks on some unknown physiological principle. These assertions are sustained by certificates of clergymen, reformed men, and others, and are accepted as facts without question or other evidence. Dogmatic statements and bold assertions, coupled with savage criticism of those who dare to doubt, together with half-truths and wild theories, mark all the literature of this specific. The commercial side of this remedy is equally startling and Napoleonic as a business success. It is a curious fact that this particular cure is very closely followed in all its details and claims by a number of imitators, who have made equally wonderful discoveries in precisely the same way, but all are concealed for the same pretended reasons. It is equally curious to note the absence of novelty and originality of methods compared with the means and efforts used to make popular and create a sale for most of the proprietary articles on the market to-day. All

these specifics for the cure of inebriety are without any practical interest except as phases of the psychology of the drink disease. It is very evident that they could not attract attention on their merits, and the means and appliances used to bring them into notice. Their existence depends on a psychological subsoil, which would favor the growth and culture of any remedy involved in mystery, and promising marvelous cures in a brief time. This subsoil is simply the expectant credulity of a large number of persons, who recognize the possibility of disease in inebriety. Without this all specifics, no matter how wisely and shrewdly presented, would fail. The conditions are all ripe for such empiricism, and its growth, life, and death are governed by causes unknown to and beyond the control of its boastful authors.

Every temperance revival movement depends on some psychological subsoil of expectant credulity, and is followed by the same dogmatic empiricism and the same wonderful cures, and hysterical confidence of permanent results. Certificates of cure, and enthusiastic praise of means and methods of far greater magnitude than that which follows any specifics, could be gathered and noted after every temperance revival.

The specific cures of inebriety to-day have appeared many times before in the history of the past. Often the empiricism associated with it has been entirely moral and ethical, and at other times it has been pecuniary and selfish. The old Washingtonian movement was a good illustration of a great specific cure, bound up with a great tide of moral empiricism, which for years created intense interest.

The presidential campaign of 1840 was notorious for the excessive use of hard cider, whisky, and rum. Every political meeting was marked by the free use of these spirits, and as the excitement of the struggle increased, temperance men drank, moderate drinkers became drunk and delirious, and never before or since has the excitement of politics been so intimately associated with inebriety in all its forms.

At the close of the campaign it was estimated that over half a million voters were practically inebriates, or had been repeatedly intoxicated during the excitement and excesses of the campaign.

Newspapers and court records showed clearly that a high tidal wave of drunkenness and moderate drinking existed at that period. Then followed the inevitable reaction, and at this moment the Washingtonians appeared. A few months before, a small drinking club in Baltimore changed to a temperance society, and called themselves Washingtonians. Its members were reformed men, and its leader, John Hawkins, was an enthusiastic, passionate orator, who urged the pledge as a remedy for

drunkenness with intense earnestness. The excitement of the political campaign and its drink excesses had prepared the public mind for this great emotional remedy—the pledge. John Hawkins's infectious earnestness animated his followers, and roused up an army of lecturers which scattered to every town and hamlet all over the country. The campaign excitement of 1840 appeared again in a great temperance reform wave, which steadily grew in numbers and enthusiasm up to 1847, when a high tidal point was reached and reaction began. Over a million persons signed the pledge, and the evils of drinking and alcohol were discussed in almost every neighborhood in the country. Never before had any reform movement been prosecuted with such terrible earnestness and contagious enthusiasm. All selfish motives and personal interests seemed to disappear in the one great purpose to pledge the victim and inspire him to avoid spirits and lead a temperate life. The spirit of the old crusaders seemed to have reappeared again. This was literally a psychological storm-wave, the reaction in part of the campaign of 1840, and the outgrowth of obscure psychological conditions, which had been prepared for a long time before. It crossed the continent and was felt everywhere, and a few years later was only known in the history of the past. While a number of inebriates were restored, its real work and value were in a different direction, not yet fully realized. It seemed to be a great force that fused and mobilized a tide of oncoming truth, and was literally a forerunner, indicating new and clearer conceptions of inebriety. It not only broke up old theories, but opened up new ranges of work, and gave glimpses of more effectual methods for cure.

The first inebriate asylum in the world grew out of this movement, and all the various temperance organizations date from the same source. Even the Prohibition party is the outgrowth of this reform-wave.

It was the first great psychological evolution of the drink question, giving an impetus and inspiration to its study, above all moral and political considerations. It was also a great empirical epidemic which assumed that the drink evil was the result of a feeble will, the remedy for which was the pledge, supported by personal sympathy in organized societies. It was a moral and ethical empiricism, based on the purest and highest motives; had it been founded on truth, would have lived as a great power in the upward movement of the race. In this connection it will be of interest to trace another great wave of empiricism, that created intense interest for a time. Unlike the Washingtonians, it was thoroughly mercenary, and, like the present specifics for inebriety, it was born in mystery and sustained by credulity and dogmatism.

The experiments of Galvani in 1785 attracted great attention. The most extravagant expectation of the practical value of galvanism in curing disease gradually spread among non-experts all over the scientific world. Various empirics appeared claiming remarkable results based on this new force. Finally, in 1796, Dr. Perkins, of Connecticut, announced that he had discovered two metals which, combined in a secret way, possessed marvelous powers of galvanism, which he called tractors, or pullers-out of disease. These tractors resembled a piece of gold and silver fitted together, about four inches long, and were used, by being moved up and down over the part affected, to draw out the disease and restore the vital forces. Almost every disorder known was cured or relieved by this means. The discoverer challenged the world of science everywhere, and invited criticism, and pointed to the persons cured for irrefutable evidence. The psychological soil was prepared, and the army of credulous enthusiasts were all ready to welcome him. In two years these tractors attained great popularity in this country. They were literally recommended and indorsed by the faculties of three medical colleges, and vast numbers of clergymen, members of Congress, and public officials. A special patent was issued, and signed by George Washington, as a slight recognition of the great service the inventor had rendered the world. Pamphlets, sermons, lectures, papers, and even books were written and scattered everywhere, giving the theories and results following the use of these tractors. In 1798 Perkins went to London. His boldness and dogmatism immediately commanded popularity. After a time a hospital was established, called the Perkinson Institute, officered by the nobility, with Lord Revois as president. Large sums of money were given for the treatment of the poor by this method. Free dispensaries were opened, and trained assistants used these tractors for all cases, with boasted success. Lectures were given on the philosophy of this method, and students were instructed and sent out to open branch institutes. The rich purchased these tractors and became their own doctors, and the poor were obliged to accept treatment from others. With empiric shrewdness, certificates of cure were gathered, which exceeded ten thousand in number, and were signed by princes, ministers of state, bishops, clergymen, professors, physicians, and wealthy laymen. The inventor was recognized as a great public benefactor and pioneer, also one of the few immortals who would live down the ages. Perkinsism seemed to have won a place in the scientific history of the world. By and by this gilded cloud of popularity burst, and the charm was dissolved. Two physicians made tractors of wood and sold them as the original, producing the same results and the same crop of certificates of cure. After making a respectable sum of money, they pub-

lished their experience, together with the thanks and public prayers for the great blessing conferred on the world by these means. Like the "South Sea bubble," Perkinsism dissolved and was no more. The branch institutes for treatment by the tractors closed for want of patients, and the tractors disappeared. Behind all this tremendous enthusiasm for the good of science and humanity appeared a commercial spirit that was startling.

These tractors were claimed to be gold and silver, and sold at from ten to twenty-five dollars each. In reality, they were made of brass and polished steel, at a cost of about twelve cents each, in an obscure Connecticut village, from which they were shipped to the inventor, who sent them all over the world. Of course, Perkins made a fortune, which compensated in a measure for his sudden fall from greatness.

While this was a great empirical epidemic, with a mercenary object, based on a few half-defined truths, it materially furthered the growth and evolution of this subject. Many of the wild theories which gathered about Perkinsism suggested clearer conceptions to later observers. Like the specific inebriety epidemic, it began as an assumed discovery of some new power, claimed from metals (not used), with some new physiological action by some new process, enveloped in mystery and only known to the discoverer. The tractors were patented, and only made by Perkins, and the certificates and statements of those cured furnished all the evidence. Literally, the effects were entirely mental, depending on the credulity and expectancy of those who claimed to be helped.

The present epidemic wave for the cure of inebriety is hardly up to the average of former empiric efforts in adroit manipulation of the credulous public.

The successful charlatan of modern times has always exhibited some psychological skill in the display of assumed truth and the concealment of his real motives. In these inebriety cures there is a coarseness of methods, with brazen assumptions and display of pecuniary motives, that quickly repel all except the unthinking. The circulars, statements, and appeals to the public are overdone, and sadly lacking in psychological skill. A certain crankiness, with strange combinations of rashness and caution, stupidity and cunning, strongly suggests that inebriate intellects are the guiding spirits in the management of these cures.

On the other hand, the very spirit and hurry of the movement suggest a full recognition of the brevity of the work and the need of active labor before the "night cometh when no man can work." In this the highest commercial and psychological skill appears. Dependence for popularity of the cure on the emotional

enthusiasm of reformed inebriates also suggests a short life and early oblivion, of which every temperance and church movement for this end furnishes many illustrations.

There can be no doubt of the fact that a certain number of inebriates are restored by each and all these various methods of cure, and a certain other number, always in the great majority, are made worse and more incurable and degenerate by the failures of such means. But, above the mere curing of a certain number of cases, a great psychological movement is stimulated, and a wider conception of the evil follows of permanent value. The inebriety specifics are epidemics of empiricism that will pass away soon, but they will rouse public sentiment and bring out the facts more prominently as to the disease of inebriety and its curability. This second stage of this truth resembles the "squatter period" of every new Territory—a stage of occupation by squatters, fortune-hunters, and irregulars of every description, who rouse great expectations, build canvas towns, making a show of permanent settlement, and attract crowds of credulous followers, only to prey on them. These persons always disappear when the real settlers come. They never develop any lands or discover any new resources, but prepare the way and concentrate public attention for the final occupation. The specific vaunter of to-day is the squatter settler, who will soon disappear, and be followed by the real settler and the scientists.

Inebriety, its causes and possible remedies, are a vast, unknown territory, the boundary lines of which have been scarcely crossed. The facts are so numerous and complex, and governed by conditions that are so largely unknown, that dogmatism is ignorance and positive assertions childishness.

The recognition of disease is only recently confirmed by the accumulation of scientific facts, although asserted and defended for a thousand years as a theory. The realm of causation is still invested with moral theories, and moral remedies have been used in the same way for a thousand years. While science has pointed out a few facts and possible laws of causation, and indicated certain general lines of treatment, it gives no support to the possibility of any specific remedy that will act on an unknown condition in some unknown way. Inebriety is literally an insanity of the border-line type, and a general condition of central brain defect, unknown, and at present beyond the power of any combination of drugs. To the scientists, all this confusion of theory and empiricism hides the real movement, and is in itself unmistakable evidence that somewhere in the future the entire subject will be known, not as a statement or theory, but as scientific truths established on scientific evidence beyond all doubt.

The specific epidemic delusions for the cure of inebriety will quickly disappear, as others have done before, and its real value to science and the world will appear from future psychological studies.

THE EVOLUTION OF DANCING.

By LEE J. VANCE.

IN his Descent of Man, Mr. Darwin refers briefly to the queer antics and dancing performances of birds during the excitements of courtship. He shows that such actions are made by the male to charm the female. The plain inference is that from the amatory feelings arises not love-dance only, but dancing in general.

Now, I think Mr. Spencer would say that the relation between courtship and dancing is not a relation of cause and effect; that the two are simultaneous results of the same cause—namely, overflow of animal spirits and vivacity of every kind. The spirit that moves men to shuffle their feet, kick up their heels, even to gambol madly until they swoon from exhaustion, may come from different feelings: now from youth, health, and exuberant spirits, and now from joy or triumph, defiance and rage.

> "On with the dance! Let joy be unconfined;
> No sleep till morn, when youth and pleasure meet."

In brief, dances as representations of love-making are not frequent among the lower races, while mystic, festive, and erotic dances are numerous enough. Only among the more advanced races, as the semi-civilized peoples of Asia and among the European peasantry, do we read of love-dances, and, oddly enough, these are performed usually by women, not by men.

Dancing, as an art, has been of gradual growth, and subject to the law of evolution. Wild, irregular, and fantastic dancing performances take after a while more regular and more artistic forms. Thus, we are able to show how savage dances, as of the Australians, develop into barbarous dances, as of the American Indians, while these in turn are modified, or perhaps improved, by more advanced peoples, as the Egyptians; how, again, in the early dances of Greece, in the Greek *mysteries*, there are survivals of the "mad doings," as Plutarch calls them, of savage races.

Folk-dancing was the first to rise into finished art. It has been rightly called "the eldest of the arts," just as music is the youngest. Beginning as a desire to kick, dancing grows into pantomime, which expresses a thought. As an art factor folk-dance

can not be overrated. Out of the old rural songs and the local cultus dances—known as mysteries and religious festivals—the marvelous structure of Greek drama was evolved. Dionysus, the god of orgies, of wine, of Bacchic revel, became in course of time the patron of the drama. Indeed, several of the great dramatists, as Æschylus and Sophocles, were clever and skillful dancers, who led in the chorus. They introduced the traditional dances

FIG. 1.—AN IROQUOIS DANCER IN COSTUME, WITH MASK, STAFF, AND TURTLE-SHELL RATTLE.

in their plays for an artistic purpose; while the songs that were sung to the accompaniment of the dance took a more formal shape in that kind of poetry known as the ballad.

For the purposes of this discussion, folk-dancing may be divided into three classes: First, we have social dances. They are for pleasure or amusement, sometimes comic and sometimes erotic. In the second class let us place war-dances. They are expressions

of defiance or rage, and they survived in the military dances of the Greeks and Romans. Thirdly, we have religious dances of various kinds. They are arranged usually by "medicine-men" or priests; they are magical in character, and are connected with some rite or superstition. The savage invariably confounds dancing with religion. His most elaborate dances are associated with mystery-plays, setting forth in action the story of some traditional event or some deity. The leaders of the revels are medicine-men or chiefs.

Now, it is a matter of common report that uncivilized people spend half their time in dancing. Thus, we read that the chief occupation of the Indians of southern California used to be dancing when the men were not engaged in procuring food.* The Spaniards have been noted for their saltatory expertness, and yet Cortes and his followers were surprised to find the art so much in favor in Mexico. The Spanish historian Herrera says that in dancing "no part of the world exceeds New Spain." He adds, "though many of those dances were performed in honor of their gods, the first institution of them was for the diversion of the people, and therefore they learned the same from their childhood and were singularly exact."†

Aside from the speculation as to "the institution" of dancing, the phrase "singularly exact" is here worthy of some notice; for it is a mistake to suppose that the savage dances hap-hazard, without any rule of action. On the contrary, the "medicine-dances" of the Indians are danced in a certain, definite way. Whether it be for rain, for green corn, or for success in the chase, the dancer follows the steps and paces fixed and regulated by tradition or custom.

Let me observe that mystic dance is a serious business. It behooves the dancer to be "singularly exact" when a *faux pas* would result in his death. This point is very strongly put by Dr. Franz Boas, who studied the dances of the coast tribes of British Columbia. (Among the Kwakiutl Indians, "any mistake made by a singer or dancer is considered opprobrious. At certain occasions *the dancer who makes a mistake is killed.*"‡) The ancient Mexicans did not mind putting an awkward dancer out of the way, and the savage practice has been found in one or two other parts of the world.

The punishment does not seem so severe, when we consider the cruel rites and initiations a dancer must pass through, ere he knows the secrets of the order or of his tribe. The savage is great on fierce initiations. He joins this or that secret order, this or

* United States Geological Survey west of the One Hundredth Meridian, vol. vii, p. 29.
† History of America, vol. iii, p. 227. ‡ Journal of American Folk Lore, vol. i, p. 51.

that dancing society, either to show his endurance or to learn the awful revelations which may make him a priest or chief. The cruel rites begin in childhood days.* Thus, every Zuñi boy of the age of four or five has no choice about being initiated into the *kok-ko*, the principal feature of which is a brutal whipping.

FIG. 2.—DANCING PARAPHERNALIA: SHAMAN'S SHIRT. (Front view.)

This practice reminds us of the initiations into the mysteries of Artemis, wherein Spartan boys were cruelly scourged.†

What makes early dancing sacred are cruel ceremonies which give sanction to secrecy. The more severe the initiation the more sacred is the dance. "A man who wanted to get the secrets," said Pipe Chief to George Bird Grinnell, "had to go through a severe trial, such as dancing and fasting."‡ The severe trial in the Pawnee Young Dog's Dance consisted in the candidate having his breast cut, and strings or sticks passed through the slits, which were tied to posts, and then the dancer endeavored to break loose by tearing out the skin.

Mr. Paul Beckwith describes a Dakota "medicine-dance," given in midwinter, and "one can readily imagine the agony the candidate must undergo, clothed only in a coat of paint."

* Mrs. Stevenson, in the Fifth Annual Report on Ethnology, p. 552.

† Pausanias, iii, 15. ‡ Journal of American Folk Lore, vol. iv, p. 307.

The Sioux have a "Sun-Dance," in which the dancers move their bodies from side to side, forward and backward, so as to stretch the gashes in their breasts and shoulders to the fullest extent. "To see one undergoing this fearful torture called dancing," writes Mr. Beckwith, "naked, painted black, hair streaming, blood trickling from their gashes, is a dreadful sight indeed." *

Let us next observe a remarkable feature of early dancing. There are dances that women may not see, on pain of death. So, too, the women have dances from which the men are rigorously excluded. The Aleuts, according to Mr. Dall, have mysteries sacred to the males and others to the females.† He says that "hundreds

FIG. 3.—SHAMAN'S SHIRT. (Back view.)

of women, wearing masks, danced naked in the moonlight, men being rigidly excluded, and *liable to death if detected in intruding.*" Mrs. Erminnie Smith mentions a moonlight dance by women of the Iroquois tribe. As to the exclusion of the women from secret dances of the men, and the men from dances performed in secret by women, a number of interesting instances might be added.

* Smithsonian Report, 1886, Part I, p. 250. In Harper's Weekly, December 13, 1890, there is a full-page picture of a Blackfeet brave undergoing the torture in the sun-dance. The spirited drawing was made by Mr. Frederic Remington on the spot.

† Third Ethnological Report, p. 139.

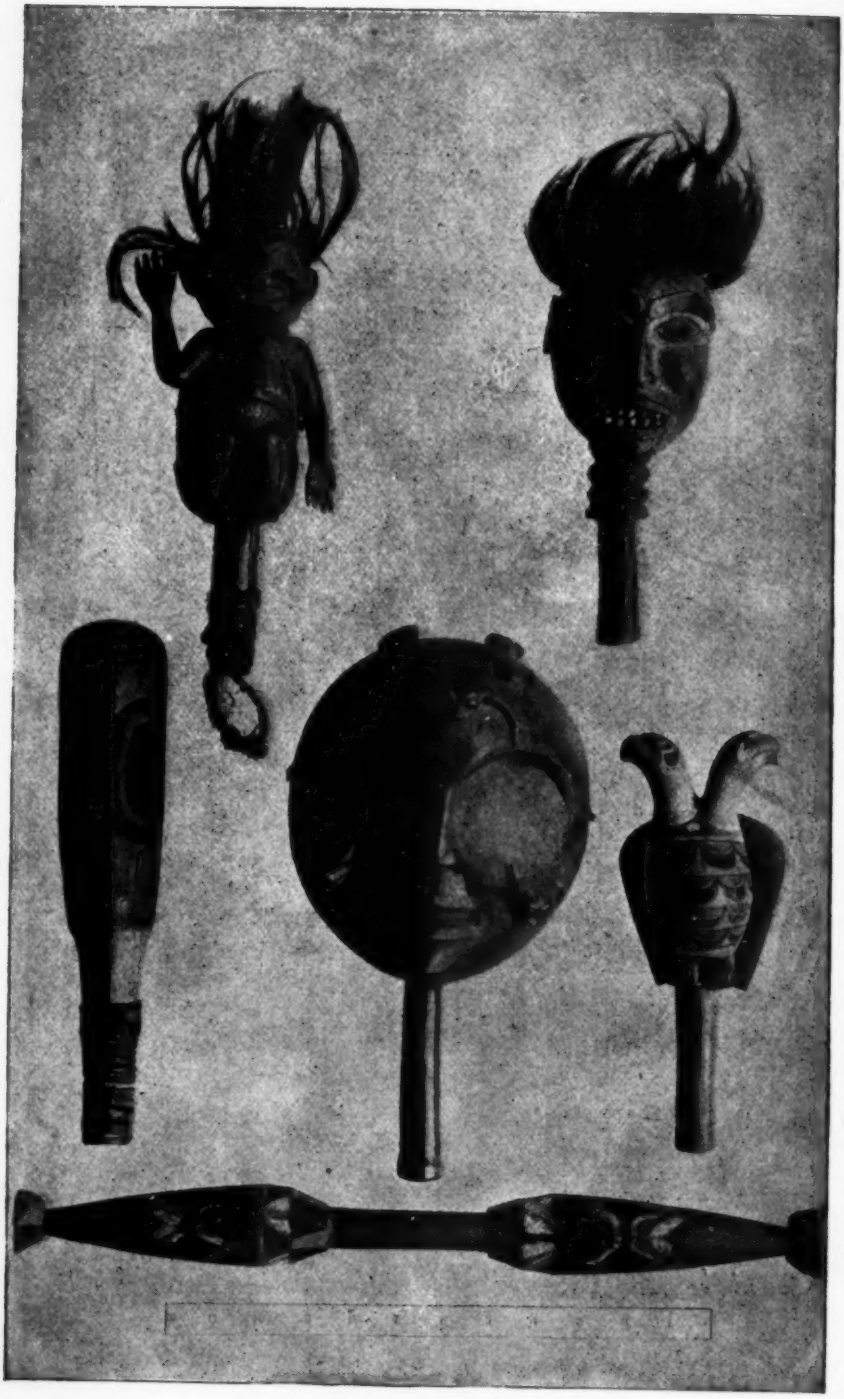

Fig. 4.—Whistles and Rattles.

The natives have stories of the awful consequences that follow if a man or woman intrudes upon a dancing party or place. The Eskimos build large houses for dancing, "which are devoted to spirits."* One evening a woman with more curiosity than prudence entered the sacred house. She touched the *tornaq*, or spirit of the house, and "all of a sudden she fell down dead." According to Mr. Derby, the Indians of the upper Xingu dance within a feast-house or "flute-house," and "any women who should venture to enter this house would die."† A rattle is used by these Indians to call the dancers together, and to warn away the women. In Brazil, some tribes make a loud noise on "jurupari pipes," which answer the same purpose. No woman is allowed to see the pipes. Again, a little instrument known to English boys as the "bull-roarer" is used in mystic dances. In Australia, the *turndun* (as the bull-roarer is there called) is never shown to women, who flee and hide themselves when the sound is heard.‡ Wherever found, be it in Australia, in Zululand, or in New Mexico among the Zuñis, the bull-roarer is regarded with religious awe.

FIG. 5.—THE WHIZZER.

Another feature of these medicine-dances is the habit of daubing a candidate with clay, paint, or dirt of any kind. As to the meaning of the practice there is a difference of opinion. The daubing is meant sometimes to be weird and grotesque; sometimes totemistic, when animals, plants, and stars are represented. In the Young Dog's Dance, above mentioned, the braves were painted red over the whole body, and, among other decorations, on the pit of the stomach a black ring, which "represented themselves—their life"—so Mr. Grinnell interprets it.

Then there is the habit of wearing masks and odd costumes. Some of the masks represent the human face; others are fashioned after the totem; others, again, are nondescript. The Aleuts, says Mr. Dall, "had the usual method of dancing with masks on during the progress of the several sorts of ceremonies."# For ordi-

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* Sixth Report of the Bureau of Ethnology, p. 597. † Science, Sept. 7, 1888, p. 118.

‡ It is a flat piece of wood tied to a string, and, when whirled around, causes a peculiar muffled roar. Kamilaroi, etc., by Howitt, p. 268.

Third Report of the Bureau of Ethnology, pp. 138, 141.

nary dances the masks are "excellent representations of the Aleutian type of face." In the New Hebrides group of islands, "masks are used in dances which the women are prohibited from

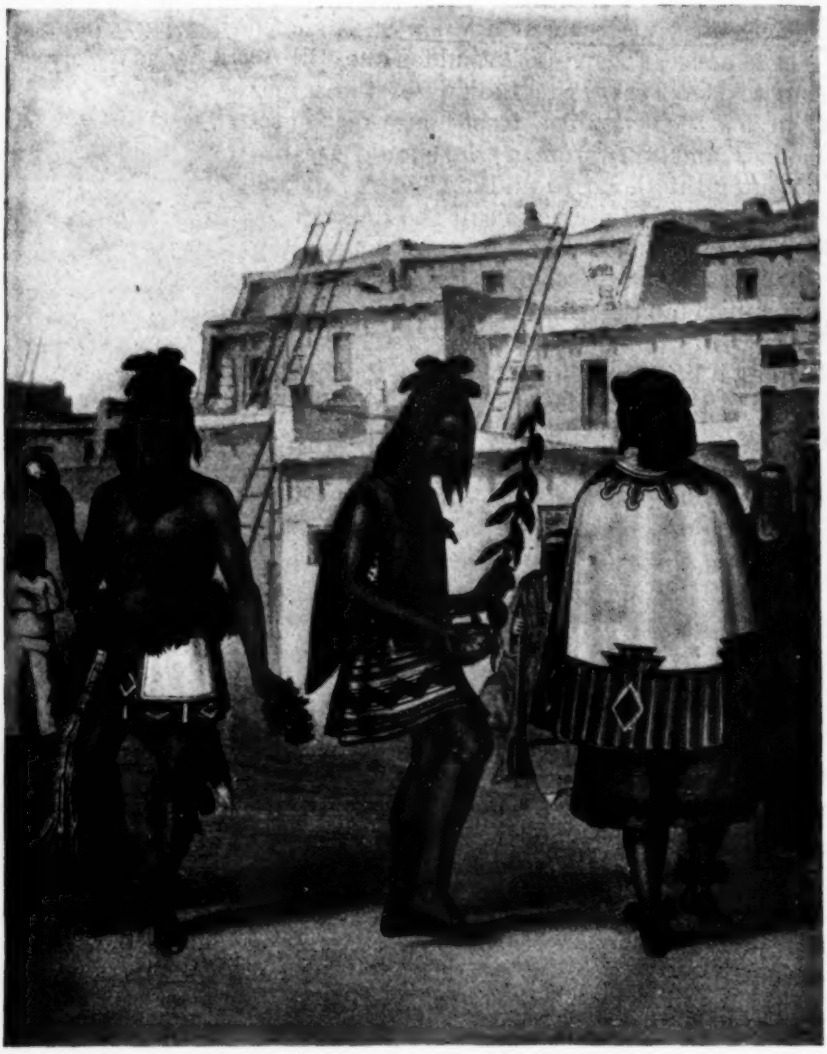

FIG. 6.—AGRICULTURAL DANCE.

seeing."* Now, just as with the bull-roarer, so it is with masks used in secret dances—the women are forbidden to see them.

We now pass to dances of people in the agricultural stage. They are performed for rain, for the fertility of the land, for bountiful harvests, and in honor of the deities that preside over

* Third Report of the Bureau of Ethnology, p. 141.

the department of agriculture. As a rule, dances appropriate to seedtime and harvest are partly secret, partly public. At one time or another the whole people participate in the festivities. Among the Seminole Indians, the Rev. Clay MacCauley informs us, as the season for holding the "green-corn dance" approaches, the medicine-men assemble and, through their ceremonies, decide when it shall take place.* The Iroquois have also a green-corn dance—a September festival lasting three days. The "Great Feather-Dance" is performed at this time by a band of costumed dancers. It is one of the most imposing dances of the Iroquois. "The Great Feather-Dance," says Mrs. Converse, who witnessed the ceremonies in the fall of 1891, "is quite unlike the war-dance. In its performance the dancer remains erect, not assuming those warlike attitudes of rage and vengeance which plainly distinguish the two dances." †

The most elaborate dances in vogue among the Zuñi Indians are those performed to obtain rain for the growing crops. The course of the sun at the summer solstice is watched by the priest, who counts the days for the dances. Then the herald announces from the house-tops that the time for the rain-dances has arrived, and all are summoned.‡ During the summer there are eight *kor-kōk-shi*, or "good dances" for rain." A strange feature of one or two of these rain-dances is the appearance of clowns, who introduce a comic element into the sacred ceremonials.

But stranger still is the use of serpents in the medicine-dances around seed time. The striking example is that of the Moqui "Snake-Dance," an account of which fills a book.* As to the origin and significance of this wonderful dance, in which venomous snakes are carried in the hands and mouths of the performers, we do not undertake to decide. Captain Bourke says that "one of the minor objects of the snake-dance has been the perpetuation, in dramatic form, of the legend of the Moqui family." He inclines to the belief that the dance is a form of serpent-worship. On the other hand, Mr. Walter Fewkes has recently put forth the suggestion that the Moqui snake-dance "is a simple form of water ceremonial." ‖ According to his view, the snake was first introduced into the dance as a symbol of water, and the predominance given to the snake in the ceremonials is the result of later additions to the primitive ceremonial.^

* Fifth Report of the Bureau of Ethnology, p. 522.

† Journal of American Folk Lore, vol. iv, p. 75.

‡ This summons or invitation to the harvest or agricultural dances is a common practice.

* The Snake-dance of the Moquis. By Captain John G. Bourke.

‖ The Meaning of the Snake-dance, in Journal of American Folk Lore, vol. iv, p. 137.

^ See also Mr. Fewkes's paper, A Few Summer Ceremonials at Zuñi Pueblo. The curi-

FIG. 7.—FIRE-DANCE.

It is not generally known that Pawnee, Dakota, and Zuñi rites and initiations were retained in the religious dances of ancient Greece. The use of the *conus*, or bull-roarer, the practice of daubing the candidate with clay or dirt, the wearing of masks, the use of serpents—these all are found in the Greek mysteries. It is undeniable that, in their mysteries, the Greeks danced much as the Iroquois, Kwakiutls, and Zuñis dance in their secret rites. The goddess Artemis, at Brauron, in Attica, was served by young girls, who imitated in dances the gait of bears. So, too, we have the wolf-dances of the Hirpi, in which the performers clothed themselves in the skin of the wolf whose feast they celebrated.* Even after the Greeks gathered into walled cities, mystic dances ("medicine-dances" the Indians would call them) took place in the local fanes of the tribal gods and around the ancient altars.

Take, for example, the mysteries of Demeter, "she of the harvest home," "of the corn-heaps." Two mysteries are well known to classical scholars as the Eleusinia and the Thesmophoria. In the former, after purifications, the *mystæ*, the initiate, performed wild and erotic dances, and in later days, when the Eleusinian rites became part of the state religion of Athens, there was, in conclusion, a spectacular miracle-play representing the sorrows and consolations of Demeter—the most touching, most pathetic figure in Greek mythology. The Thesmophoria was the feast of seed time. The Greek matrons performed certain sacred rites and secret dances, which the men were prohibited from seeing. Heroditus says that the Thesmophoria were brought from Egypt, where the women danced in similar fashion before the altar of the bull-god in the Memphian temples. There must have been some licentious doings in the Greek mystery, or else the plain-spoken historian would not have "omitted them by silence." His apology for concealment is neatly put: "As they refused to tell for religion, so we desired not to hear for modesty."

The important feature of all mysteries, savage or Greek, is dancing. Lucian, in his Treatise on Dancing, says: "You can not find a single ancient mystery in which there is not dancing. . . . This much all men know, that most people say of the revealers of the mysteries that they 'dance them out.'" Mr. Andrew Lang, who has made a close study of Greek mysteries, quotes the reply of Quing, the Bushman, who was asked about some myths of his people. Quing replied: "Only the initiated men of that dance know these things." Hence to "dance out" this or that, observes Mr. Lang, means to be acquainted with this

ous masks and customs are represented by photographs; the music was taken with the phonograph.

* Aristophanes, Lysistratra, 646.

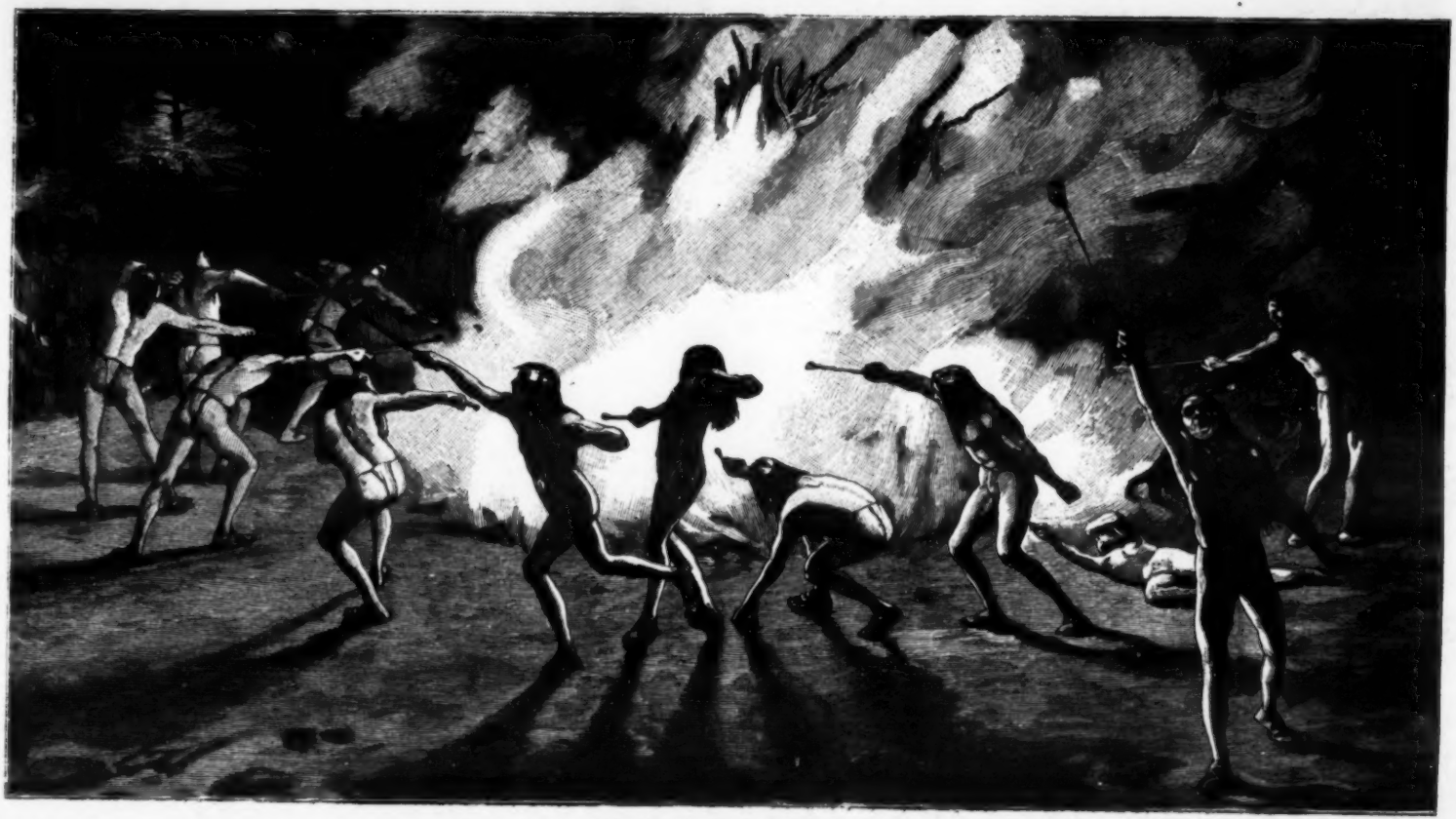

FIG. 8.—DANCE OF NAHIKAI.

or that myth, which is represented in a dance or *ballet d'action.** This brings us to the point we would be at. The medicine-dances develop into mystery plays, setting forth this or that myth, which in turn reached artistic development in the old Greek drama.

The most striking example of barbaric drama is that of "The Mountain Chant" of the Navajo Indians. The ceremonial, lasting nine days, presents in a dance or series of dances a myth of tribal history, beginning at a time when the Navajo became a distinct people.† The significance of the "chant" has been stated concisely by Major J. W. Powell: "This ceremony dramatizes the myth with rigorously prescribed paraphernalia and formularies, with picturesque dances and shows, scenic effects, and skillful thaumaturgic jugglery. It is noticeable also that here the true *popular drama is found in the actual process of evolution from religious mysteries or miracle plays.* . . . It is to be remarked that the Shaman has become the professional and paid artist and stage manager, under whom is gathered a traveling corps of histrions and scenic experts." ‡

Here is the proper place to observe that dancing has a bearing on the development of the social order. The medicine-men or priests gain and retain political and social powers through their skill in leading the dance. According to Mr. Beckwith, "the high priest in the religious ceremonies of the Dakotas is *invariably a chief* who, through these dances, retains his influence in the tribe." # Thus, dancing gives sanction to the powers of the chief, and is one of the necessary qualifications for the office. It is thus associated with position and rank. In the Vedic age (2000 B. C.), before the rigid division of castes, the priests were leaders of the dance at the festivals. ‖ Later on they became all-powerful Brahmans. The Homeric chiefs were distinguished dancers. Lucian says that Troy was taken, Zeus was saved, and Ariadne ruined by a dance. And David led the dance before the ark. The ancients regarded dancing as a necessary accomplishment. Socrates learned the art in his old age; while Plato, in his Commonwealth, advocated the establishment of dancing schools. The Romans celebrated their victories and pastoral festivals by elaborate dances. They excelled in pantomime dances, from which the ballet was evolved.△ The Emperor Domitian forbade

* Custom and Myth, p. 42.

† A description of the ceremonies, together with sketches, has been furnished by Dr. Washington Matthews (Fifth Report Ethnology, pp. 385–468).

‡ Fifth Report of the Bureau of Ethnology, p. xlvi.

Smithsonian Report, 1886, Part I, p. 245.

‖ Weber, p. 37.

△ Until early in the seventeenth century the performers in the ballet were men.

the senators to dance, and for so doing removed several members from the senate. Grave statesmen and politicians of high degree

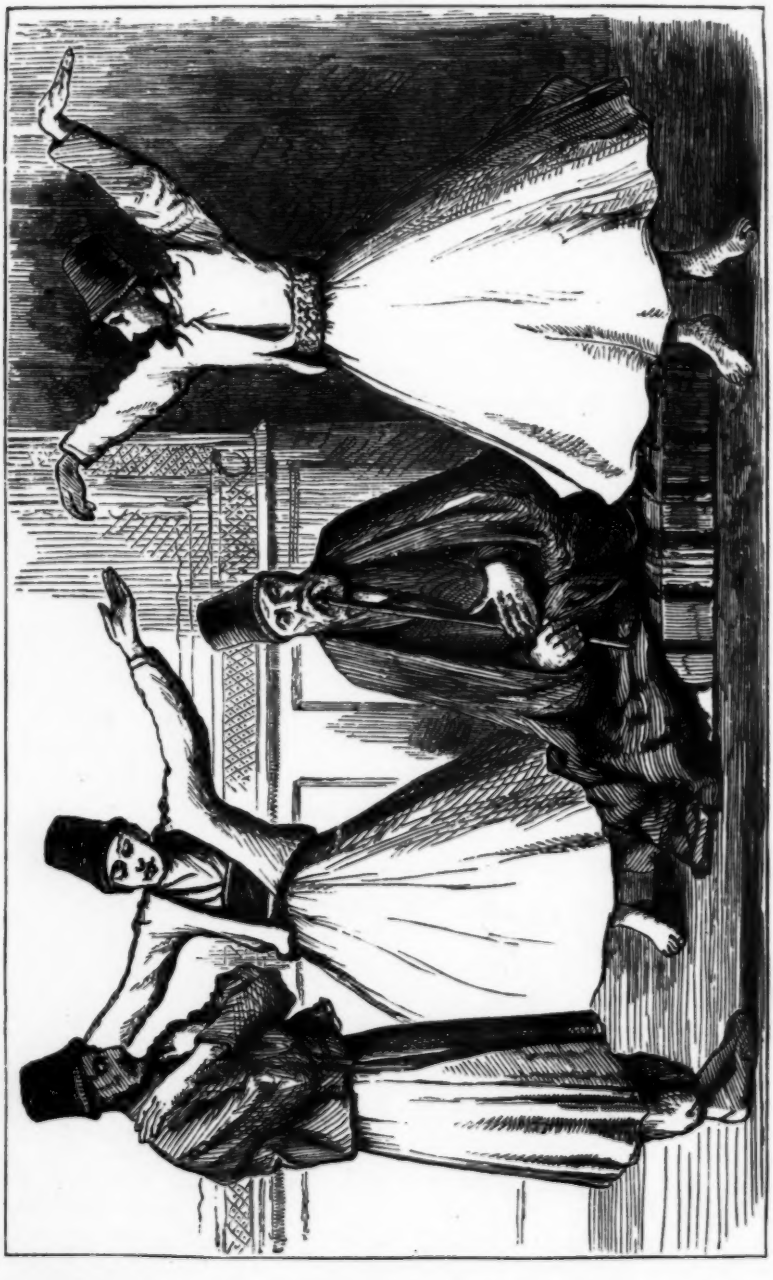

FIG. 9.—DANCING DERVISHES.

have excelled in the eldest of the arts. Both Sully and Cardinal Richelieu were expert dancers. Think of the august cardinal

paying his court to Anne of Austria, by performing a saraband before her in jester's dress of green velvet, with bells on his feet and castanets in his hands!*

Long after dancing became secularized, it remained part and parcel of divine services. Gregory Thaumaturgus introduced prancing into Christian ritual; and Scaliger derives *præsules*—a name given to the bishops—from *a præsiliendo*, from the fact of their "skipping first," or leading the clergy, in the altar-dances. In the middle ages the Mystery Plays were simply choral dances and songs. There were biblical stories and "moral lessons" told to the folk. The famous Dance of Death was a popular spectacular play, in which pope, cardinal, king, prince, and pauper were invited by the gay and festive skeleton to dance with him, and there was no alternative. Finally, as a survival from the mediæval Church, we have the Corpus Christi dances, which were performed until within late years by the congregation in the Seville Cathedral.†

The orgiastic impulse is one of the wildest and most rebellious passions in human nature. It is continually breaking through the thin veneer that civilization supplies. It has shown itself at different times in Europe.‡ This "passion of Dionysus" takes possession of the folk, of the people in the country, on heath or by sea. (The impulse which seizes girls in modern Greece is so strong that they dance themselves to death on the hills.) The dancers are victims of the Nereids, say the peasants. In ancient Greece, as Mr. Lang observes, they would have been saluted as the nurses and companions of Dionysus, and their disease would have been hallowed by religion.*

It needed only a young Cheyenne to fall into a trance, to dream that he had seen and talked with the Christ, to proclaim himself a prophet of the new religion, to begin dancing in fast and furious fashion—it needed only this to start the "Messiah craze" in the fall of 1890.‖ The dancing mania soon seized the Indians, and, within a month, the Cheyennes, Pawnees, Comanches, Arapahoes, Kiowas, Wichitas, and other smaller tribes were performing the "dance to Christ," called by the whites the "Ghost-

* In the days of Queen Bess—the queen herself an adept in the art—"the grave Lord Keeper led the brawls," without losing his own respect and dignity.

† In the *autos sacramentales*, or miracle plays, dancing was introduced in honor of the sacrament. The little choir boys of the cathedral still dance before the Host every evening at five o'clock.

‡ See Lecky's Rationalism in Europe, vol. i, p. 77, for the "dancing mania" of Flanders and Germany.

* Myth, Ritual, and Religion, vol. ii, p. 241.

‖ Miss Alice Fletcher says the "craze" would have died out had it not been for the medicine-men or conjurers, who "multiplied stories and marvels."—*Journal of American Folk Lore*, vol. iv, p. 60.

Dance." "They will dance," says one witness, "from Friday afternoon till sundown on Sunday. They keep going round in one direction until they become so dizzy that they can scarcely stand, then turn and go in the other direction, and keep it up until they swoon from exhaustion. That is what they strive to do, for while they are in a swoon they think they see and talk with the new Christ." Now, observe: "At the end of the dance they have a grand feast, the revel lasting all Sunday night."*

Thus far little has been said about the different movements and steps of ancient dances. What the figures "woven paces and waving hands" in early Greek dances were, no one can say with exactness. The earliest description of dancing which we can reproduce is the account of the dance on the shield of Achilles, which bore the sculptured scene

"Of youths and maidens bounding hand in hand.

. . . . . .

Now all at once they rise, at once descend,
With well-taught feet; now shape in oblique ways
Confus'dly regular the moving maze;
Now forth at once, too swift for sight, they spring,
And undistinguished blend the flying ring:
So whirls a wheel in giddy circle tost,
And rapid as it runs the single spokes are lost."

Here we have the simplest kind of dancing. Youths and maidens take one another by the hand, and spin round and round like a potter's wheel. This form of Homeric Greek dance in the dance of Bacchus is known as the dithyramb. It survives to the present day in the "jiggering" of children, who join hands and prance around in a circle.

Later on, the Greeks divided dances into round and square. Their round dances—the word "round" meaning something more than our "round"—were dances of pleasure and revelry. Their square dances were military and dramatic. The Spartans drilled their men in Pyrrhic dance to the ringing sound of spear and shield. The square dances of the ancients required some art and some practice, while little of either was necessary in their round dances.

The real charm of true dancing consists rather in a graceful swaying of the body and arms than in violent movements and complicated steps. Take, for example, the dances performed by the Nautch girls—the most enchanting and ravishing dancers in the world. In their dances you see no springs, no vehement *pirouettes*, no violent sawing of the arms, no painful contortions

* Journal of American Folk Lore, March, 1891.

of the limbs, no bringing of the legs at right angles with the body as in our *ballet*, no dizzy gyrations—in short, "none of that exquisite precision of step and pedal dexterity which constitute the chief charm of European artists."* The Spanish dances—

FIG. 10.—CSARDOS, HUNGARIAN FOLK-DANCE.

which of late have become popular—are free from violent movements and intricate steps. Indeed, the feet play so small a part in the action that the dancer seems scarcely to raise them from the ground. The dances are little more than graceful writhings and twistings of the body; the arms and legs moving in sinuous folds and contortions, like the movements of a snake; the dancer all the while beating time with the castanets held in each hand.

This brings us down to the more developed or modern forms of dancing. Different people have arranged their peculiar dances. The French have devised many intricate steps; the English had their "country-dances" round the May-pole; the Scotch invented the reel; the hornpipe was originally a Cornish dance, and so on.

* The Oriental Annual, or Scenes in India. By Rev. H. Caunter. London, 1836, p. 20, where there is a fine description of the Nautch girls in their charming dances.

Thus, we have all kinds of "national dances," so called. Oddly enough, the national dance of Hungary sets forth the drama of courtship—the shy advance, the maidenly modesty and retreat, the proposal, the rejection, but finally the open-armed acceptance. (See illustration.)

Finally, dancing follows a general law of mental evolution, namely, that practices which occupy an important place in the minds and daily doings of people in a savage stage of culture survive only as matters of amusement, or perhaps of æsthetic feeling, in a period of civilization. And such is now the place occupied by the eldest of the arts. When we regard the pavan, the gavotte, the minuet, the Sir Roger de Coverley, or the waltz, we may see in them the survivals of that primitive impulse which we often fail to recognize in camp-meetings and church "revivals."

THE NATIVE AND FOREIGN-BORN POPULATION.

VIII.—LESSONS FROM THE CENSUS.

By CARROLL D. WRIGHT, A. M.,
UNITED STATES COMMISSIONER OF LABOR.

THE native and foreign-born population of the United States has been given to the public in Census Bulletin No. 194. The designations of the foreign-born as to countries from which they came are not included in the bulletin. It is impossible, therefore, to consider any question beyond that of the distinction between native and foreign-born, with the addition of immediate parent nativity.

Native and Foreign-born Population, 1890.

States and Territories.	Total population.	Native.	Per cent of native of total population.	Foreign.	Per cent of foreign of total population.
The United States.....	62,622,250	53,372,703	85·2	9,249,547	14·8
North Atlantic Division..	17,401,545	13,513,368	77·7	3,888,177	22·3
Maine.....	661,086	582,125	88·1	78,961	11·9
New Hampshire.....	376,530	304,190	80·8	72,340	19·2
Vermont.....	332,422	288,334	86·7	44,088	13·3
Massachusetts.....	2,238,943	1,581,806	70·6	657,137	29·4
Rhode Island.....	345,506	239,201	69·2	106,305	30·8
Connecticut.....	746,258	562,657	75·4	183,601	24·6
New York.....	5,997,853	4,426,803	73·8	1,571,050	26·2
New Jersey.....	1,444,933	1,115,958	77·2	328,975	22·8
Pennsylvania.....	5,258,014	4,412,294	83·9	845,720	16·1

Native and Foreign-born Population, 1890.—(Continued.)

States and Territories.	Total population.	Native.	Per cent of native of total population.	Foreign.	Per cent of foreign of total population.
South Atlantic Division..	8,857,920	8,649,395	97·6	208,525	2·4
Delaware.....	168,493	155,332	92·2	13,161	7·8
Maryland.....	1,042,390	948,094	91·0	94,296	9·0
District of Columbia	230,392	211,622	91·9	18,770	8·1
Virginia.....	1,655,980	1,637,606	98·9	18,374	1·1
West Virginia.....	762,794	743,911	97·5	18,883	2·5
North Carolina.....	1,617,947	1,614,245	99·8	3,702	0·2
South Carolina.....	1,151,149	1,144,879	99·5	6,270	0·5
Georgia.....	1,837,353	1,825,216	99·3	12,137	0·7
Florida.....	391,422	368,490	94·1	22,932	5·9
North Central Division ..	22,362,279	18,302,165	81·8	4,060,114	18·2
Ohio.....	3,672,316	3,213,023	87·5	459,293	12·5
Indiana.....	2,192,404	2,046,199	93·3	146,205	6·7
Illinois.....	3,826,351	2,984,004	78·0	842,347	22·0
Michigan.....	2,093,889	1,550,009	74·0	543,880	26·0
Wisconsin.....	1,686,880	1,167,681	69·2	519,199	30·8
Minnesota.....	1,301,826	834,470	64·1	467,356	36·9
Iowa.....	1,911,896	1,587,827	83·0	324,069	17·0
Missouri.....	2,679,184	2,444,315	91·2	234,869	8·8
North Dakota.....	182,719	101,258	55·4	81,461	44·6
South Dakota.....	328,808	237,753	72·3	91,055	27·7
Nebraska.....	1,058,910	856,368	80·9	202,542	19·1
Kansas.....	1,427,096	1,279,258	89·6	147,838	10·4
South Central Division...	10,972,893	10,651,072	97·1	321,821	2·9
Kentucky.....	1,858,635	1,799,279	96·8	59,356	3·2
Tennessee.....	1,767,518	1,747,489	98·9	20,029	1·1
Alabama.....	1,513,017	1,498,240	99·0	14,777	1·0
Mississippi.....	1,289,600	1,281,648	99·4	7,952	0·6
Louisiana.....	1,118,587	1,068,840	95·6	49,747	4·4
Texas.....	2,235,523	2,082,567	93·2	152,956	6·8
Oklahoma.....	61,834	59,094	95·6	2,740	4·4
Arkansas.....	1,128,179	1,113,915	98·7	14,264	1·3
Western Division.....	3,027,613	2,256,703	74·5	770,910	25·5
Montana.....	132,159	89,063	67·4	43,096	32·6
Wyoming.....	60,705	45,792	75·4	14,913	24·6
Colorado.....	412,198	328,208	79·6	83,990	20·4
New Mexico.....	153,593	142,334	92·7	11,259	7·3
Arizona.....	59,620	40,825	68·5	18,795	31·5
Utah.....	207,905	154,841	74·5	53,064	25·5
Nevada.....	45,761	31,055	67·9	14,706	32·1
Idaho.....	84,385	66,929	79·3	17,456	20·7
Washington.....	349,390	259,385	74·2	90,005	25·8
Oregon.....	313,767	256,450	81·7	57,317	18·3
California.....	1,208,130	841,821	69·7	366,309	30·3

The historian Bancroft stated that in 1775 the colonies were inhabited by persons "one fifth of whom had for their mother-tongue some other language than the English." The French, the Swedes, the Dutch, and the Germans contributed this one fifth,

and in the order named. In 1890 the total foreign population numbered 9,249,547, while the total number having foreign-born parents, but who themselves were born in this country, was 11,503,675, making a total of foreign-born and children of foreign-born parents of 20,753,222—that is, one third of the total population of the United States consists of people born in foreign coun-

Native and Foreign-born Population, 1880.

States and Territories.	Total population.	Native-born population.	Foreign-born population.	Per cent of native-born of total population.	Per cent of foreign-born of total population.
Alabama	1,262,505	1,252,771	9,734	99·23	0·77
Arizona	40,440	24,391	16,049	60·31	39·69
Arkansas	802,525	792,175	10,350	98·71	1·29
California	864,694	571,820	292,874	66·13	33·87
Colorado	194,327	154,537	39,790	79·52	20·48
Connecticut	622,700	492,708	129,992	79·12	20·88
Dakota	135,177	83,382	51,795	61·68	38·32
Delaware	146,608	137,140	9,468	93·54	6·46
District of Columbia	177,624	160,502	17,122	90·36	9·64
Florida	269,493	259,584	9,909	96·32	3·68
Georgia	1,542,180	1,531,616	10,564	99·31	0·69
Idaho	32,610	22,636	9,974	69·41	30·59
Illinois	3,077,871	2,494,295	583,576	81·04	18·96
Indiana	1,978,301	1,834,123	144,178	92·71	7·29
Iowa	1,624,615	1,362,965	261,650	83·89	16·11
Kansas	996,096	886,010	110,086	88·95	11·05
Kentucky	1,648,690	1,589,173	59,517	96·39	3·61
Louisiana	939,946	885,800	54,146	94·24	5·76
Maine	648,936	590,053	58,883	90·93	9·07
Maryland	934,943	852,137	82,806	91·14	8·86
Massachusetts	1,783,085	1,339,594	443,491	75·13	24·87
Michigan	1,636,937	1,248,429	388,508	76·27	23·73
Minnesota	780,773	513,097	267,676	65·72	34·28
Mississippi	1,131,597	1,122,388	9,209	99·19	0·81
Missouri	2,168,380	1,956,802	211,578	90·24	9·76
Montana	39,159	27,638	11,521	70·58	29·42
Nebraska	452,402	354,988	97,414	78·47	21·53
Nevada	62,266	36,613	25,653	58·80	41·20
New Hampshire	346,991	300,697	46,294	86·66	13·34
New Jersey	1,131,116	909,416	221,700	80·40	19·60
New Mexico	119,565	111,514	8,051	93·27	6·73
New York	5,082,871	3,871,492	1,211,379	76·17	23·83
North Carolina	1,399,750	1,396,008	3,742	99·73	0·27
Ohio	3,198,062	2,803,119	394,943	87·65	12·35
Oregon	174,768	144,265	30,503	82·55	17·45
Pennsylvania	4,282,891	3,695,062	587,829	86·27	13·73
Rhode Island	276,531	202,538	78,993	73·24	26·76
South Carolina	995,577	987,891	7,686	99·23	0·77
Tennessee	1,542,359	1,525,657	16,702	98·92	1·08
Texas	1,591,749	1,477,133	114,616	92·80	7·20
Utah	143,963	99,969	43,994	69·44	30·56
Vermont	332,286	291,327	40,959	87·67	12·33
Virginia	1,512,565	1,497,869	14,696	99·03	0·97
Washington	75,116	59,313	15,803	78·96	21·04
West Virginia	618,457	600,192	18,265	97·05	2·95
Wisconsin	1,315,497	910,072	405,425	69·18	30·82
Wyoming	20,789	14,939	5,850	71·86	28·14
United States	50,155,783	43,475,840	6,679,943	86·68	13·32

tries or the children of people so born. It is impossible to go further back than one generation in this calculation; but in all probability, when the facts are known, we shall find that at least one half of the inhabitants of this country at the present time were either born abroad or are the children or grandchildren of persons born abroad, while one third, instead of one fifth, have for their mother-tongue some other language than the English. Future bulletins will enable us to understand this feature of the nativity of the population more clearly.

The first of the preceding tables has been constructed from those given in the bulletin named; which, however, did not give the percentages stated. It shows the total population in the United States, June 1, 1890, separated as to native and foreign-born, and the percentage of each of the total population; the second table gives like facts for 1880. (In the first table I have followed the form now in use at the Census Office, giving the States by divisions; while in the second table, for 1880, the States are alphabetically arranged.)

The State having the greatest proportion of foreign-born is North Dakota, where that element constitutes 44·6 per cent of the total population. In 1880 the State having the highest percentage of foreign-born was Nevada, it being then 41·2. Nevada now has 32·1 per cent. The State having the lowest percentage in 1880 was North Carolina, it then being ·27 per cent, and North Carolina still has the lowest percentage of foreign-born, it being but ·2 of 1 per cent in 1890. Of the population of the whole country 14·8 per cent are foreign-born. The facts are given for the different census years in the adjoining table.

Census Years.	Aggregate population.				Native-born.				Foreign-born.			
	Total.	Increase.			Total.	Increase.			Total.	Increase.		
		Number.	Per cent.			Number.	Per cent.			Number.	Per cent.	
The United States:												
1890	62,622,250	13,466,467	24·86		53,372,703	9,896,863	22·76		9,249,547	2,569,604	38·47	
1880	50,155,783	11,597,412	30·08		43,476,840	10,484,698	31·78		6,679,943	1,112,714	19·99	
1870	38,558,371	7,115,050	22·63		32,991,142	5,686,518	20·83		5,567,229	1,428,532	34·52	
1860	31,443,321	8,251,445	35·58		27,304,624	6,357,350	30·35		4,138,697	1,894,095	84·38	
1850	23,191,876	a8,122,423	35·87		20,947,974	.....	.....		2,244,602	.....	.....	

From this short table we see the changes that are going on. Taking the last census decade of years, we find that the aggregate population increased 24·86 per cent. Analyzing this, it is seen that the native-born population increased 22·76 per cent and the foreign-born 38·47 per cent. The heaviest increase in the foreign-born was between 1850 and 1860, when it was 84·38 per cent. This was soon after the great tide of immigration set in toward this country. The highest percentage of increase in the native-born population was between 1870 and 1880, so far as the decades in the table are shown, it then being 31·78 per cent. The percentage of the native and foreign-born of the total population is given in the following tabular statement:

Census Years.	Native and Foreign-born.	
	Native.	Foreign.
The United States:	Per cent.	Per cent.
1890	85·23	14·77
1880	86·68	13·32
1870	85·56	14·44
1860	86·84	13·16
1850	90·32	9·68

This little table answers very fully the question as to whether the foreign-born are increasing out of proportion to the increase of population. Leaving out 1850, as immigration had just then begun to be felt strongly, and commencing with the decade of 1860, the percentages are very interesting. In that year the foreign-born constituted 13·16 per cent of the total population of the country. In 1890 it constituted 14·77 per cent, or an increase of ·61 of 1 per cent in the thirty years, certainly not a very alarming figure. In 1870 the foreign-born population constituted 14·44 per cent, while in 1890 it was, as stated, 14·77 per cent, an increase in percentage of ·33 per cent in twenty years. The native population in 1860 was represented by 86·84 per cent of the total population, and in 1890 by 85·23 per cent.

If we examine particular sections of the country, however, we find some extraordinary proportions. Massachusetts, for instance, in 1880 had 443,491 foreign-born persons as part of her population. This was 24·87 per cent of the total population. In June, 1890, her foreign-born population numbered 657,137, and was 29·04 per cent of the total. The foreign-born population in Rhode Island increased from 78,993 in 1880 to 106,305 in 1890. The great State of New York had 1,211,379 foreign-born persons in her borders in 1880, while in 1890 this body had increased to 1,571,050. Pennsylvania showed like proportions. In Wisconsin the foreign-born population increased from 405,425 in 1880 to 519,-

199 in 1890, but the percentage in relation to the total population did not increase. In fact, in some of the Western States, where the percentage of foreign-born population of the total population in 1880 was very high, it is found to be lower now. This is because the increase in population comes to some extent from the children of the foreign-born, who figured as such in 1880. When the full results as to parent nativity are ascertainable, the comparison as to changes and the relative proportion of the foreign-born element as such in different localities can be clearly brought out, as stated.

The total native population of the country is 53,372,703, while the total foreign-born population is 9,249,547. This latter figure represents the total number of foreign-born living persons out of the total foreign immigration during the history of the country. Prior to 1819 the Government took no account of the number of immigrants, but the accepted estimate gives the total number between 1790 and 1819 at 250,000. In 1819 the Federal Government took account of immigration, and the reports have been very regular since then. The total immigration from 1819 to 1890 was 15,686,158. On June 1, 1890, therefore, there were living, of this total number of immigrants, 9,249,547. The reports of the Treasury Department furnish the information as to the character of this body of immigrants. Future reports of the Census Office will furnish information relative to the character of the living foreign-born, not only as to the countries furnishing foreign-born population, but all the other social facts relating thereto gathered by the census. A complete analysis, therefore, must be reserved for future publications of the Census Office. But, looking at the primary facts as furnished by the Treasury Department, it is learned that, of the 15,686,158 immigrants who have settled in this country since 1820, 3,503,227 came from Ireland and 4,546,800 from Germany, including Prussia. Adding these two numbers together, we find that Ireland and Germany have furnished 8,050,027 out of the total number of immigrants, or more than 51 per cent of that total. The number coming from Germany is one million, in round numbers, greater than the number coming from Ireland.

A study of the nationalities represented in the immigration to this country shows that a little more than 50 per cent of the whole number have come from Protestant countries, and if we should look closely into the matter we should find that the two great political parties in the United States absorb equal proportions of the total volume of immigration. In a theological and political sense, therefore, immigration has been quite equally divided.

When we look at industrial conditions, however, it is learned

that the absorption of immigrants has not been equal. The facts in this respect can not be given for 1890, but for 1880 they indicate what may be expected when the full facts for 1890 are reported. In 1880 the whole number of people engaged in agriculture was 7,670,493. Of this number 812,829 persons were of foreign birth; that is to say, 10·06 per cent of the whole number employed in agriculture in 1880 were foreign-born. The total number employed in manufacturing, mechanical, and mining industries in the United States in 1880 was 3,837,112. Of this number 1,225,787 were of foreign birth, and this number is 32 per cent of the whole number of persons engaged in these industries. The tendency, therefore, of our immigrants is to assimilate with our mechanical industries. This increases the supply of labor in comparison to the demand, and may in some localities tend to lower wages, and sometimes to cripple the consuming power of the whole body of the people. In 1880 12·52 per cent of the whole number of foreign-born persons were engaged in agriculture, while 18·88 per cent of the foreign-born were engaged in manufactures.

MUD AS A BUILDING MATERIAL.

By WILLIAM SIMPSON, R. I., M. R. A. S.

IT is necessary to premise that under the term "mud" I include sun-dried bricks. When bricks have been burned in the fire, the material becomes entirely changed and ceases to be mud, so I exclude them from consideration in the present paper as a building material. Wet earth made into blocks and dried in the sun differs in no way from a layer of the same laid on a wall.* Both methods were used in the East, and often combined in the same building. The reason for this is soon found out if you attempt to raise a mud wall. A layer of two or three feet thick must be allowed to dry and consolidate before another is placed on it, because the weight above would press out the soft material below, and the whole would tumble down. In some localities a layer of mud is put down at the commencement, and while that is drying bricks are made to be placed above.

It was during the cold season of 1884–'85, in traveling through Persia at the time of the Afghan Boundary Commission, that the

* Bricks of this kind, "when placed one upon another after being imperfectly dried, combined, under the influence of the weather and their own weight, into one homogeneous mass, so that the separate courses became undistinguishable. This latter fact has been frequently noticed in Assyria, by those who had to cut through the thickness of walls in the process of excavation."—Perrot and Chipiez, A History of Art in Ancient Egypt, vol. i, p. 113.

importance of mud in connection with building and architecture first attracted my attention. I had to pass from Tehran eastward, through Khorassan and into Afghan Turkestan. Along the whole of this route mud is the building material. Some of the serais—that is, caravan serais for the accommodation of travelers—are of burned brick, but these are about the only exceptions. Not only villages, but large towns, are built of mud or sun-dried brick. The defensive walls are of the same material; even such large towns as Sabzawar, Nishapur, Meshed, and New Sarrakhs are fortified with walls of this kind. On realizing this almost exclusive use of one building material, in one region, my mind naturally recalled what I had seen in India, where, although stone and fire-

FIG. 1.—THE MESHED GATE, NEW SARRAKHS, ON THE HERI RUD.

burned brick are largely used, yet the villages are over very large districts wholly constructed of mud. In Afghanistan it is the same. The fort at Peshawer, which was Afghan territory up to Runjit Singh's time, is a mud one. Jellalabad is surrounded by a mud wall. From the Khyber Pass to Tehran the towns and their defenses, as well as the villages, are almost identical in their material as well as in their general appearance.

These statements show that over a large geographical space in the Eastern world the building material at the present day is almost exclusively mud. I have been thus far speaking of what I have seen with my own eyes. To this may be added the practice of other countries. I believe that it is the same over most of Central Asia. It is now accepted that in Mesopotamia it was largely employed; and we know that in Egypt, from the earliest times to the present day, it has been the principal means employed in structural erections. It was largely used in Greece in ancient times, and also in Spain. It was known in South America and all along the Pacific coast, from Peru to San Francisco. The word "dobies," for sun-dried bricks, is a familiar term—this is derived

from the Spanish word *adobes*.* In 1873 I visited the original church dedicated to St. Francis, which gave its name to the now well-known town in California—this church was constructed with "dobies." Mud houses were not uncommon in England in the past, and they are yet known in Devonshire, where the stuff they are constructed with is called "cob." I am under the impression that the importance of mud in connection with building has hitherto been overlooked.

Once begun, the progress of mud architecture would be considerable. Those who began their architectural style with branches of trees could not have made any advance until some kind of implement was invented by means of which the wood could be cut and fashioned; and the "stone age," when stone tools came into use, is a comparatively late one in man's history. The mud builder, on the contrary, required no tools; his hands were sufficient for every purpose. He may have been content at first with an inclosure formed by four walls. A covering of grass or reeds would soon suggest itself; this, although rude and primitive, would be the first complete human habitation. But, more than that, it would be the beginning of the "house"—the "home," which, from the relations and associations it produced, must have been one of the most important steps in the history of early civilization.

The great antiquity of the use of mud as a building material can be established from a number of references to history. In Persia, at least, we have traces of it. Firdusi, in the Shah Namah, relates how Jemshid, now known as a mythical personage, introduced a better civilization among the people; among the improvements it is told how "he taught the unholy demon train to mingle water and clay, with which, formed into bricks, the walls were built, and then high turrets, towers, and balconies, and roofs, to keep out rain, and cold, and sunshine." It is naturally inferred that the bricks made by the children of Israel in Egypt were sun-dried from the use of the straw in them. The making of bricks is often represented in the sculptures of Egypt.

The first use or invention of mud for building was ascribed to mythical personages, thus attributing to it a kind of divine origin.

I shall now give a few details of the manner of building in mud, most of which are derived from what I saw in Persia. Many of the methods I saw there I have since found are also practiced in other parts of the world.

It was pointed out to me that, in the larger towns, on entering a house, you have often to descend from the level of the street to

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* *Adobes*, or *dobies*, is probably a variant of the Arabic *tob* or *toob*, allied again to the Coptic *tobi*, which was also the Egyptian word for brick.

the ground-floor. It was explained that this results from utilizing the earth on which the house stands, thus saving the expense of transporting the building material from outside the town.

In good houses a foundation is laid, varying from two to four feet in depth, formed of rough stones or broken fire-burned bricks, and piled up with mud and lime. This is carried up a foot or so above the ground, before the mud wall is commenced. In villages, where everything is rude, this foundation is made of any kind of rubbish that is found handy. This is a very interesting feature of mud architecture. Its object is no doubt to give strength where the wall would be liable to friction from the street traffic; and probably to prevent to a certain extent damp from rising. It would also be a safeguard against another serious danger—that is, if water were to accumulute by any chance round the base of the mud walls, and remain long enough to soak through, a very serious catastrophe might take place from the house tumbling

FIG. 2.—MUD-BUILT HOUSES, VILLAGE OF SIVAH, KHORASSAN.

down. I can not recall to my memory any foundation of this kind in the mud houses of India. Village houses in the north-west of that country are usually built on a *chaboolra*, which is a raised platform of mud, about a couple of feet in height, and this forms the floor of the house. This platform, by raising the foundation of the walls above the ground, may perhaps serve some of the purposes of the layer of stones in the Persian foundations.

The walls of Persian houses vary from two to four feet in thickness. This depends entirely on the quality of the house and the means of the builder. Thick walls make a cool house, and that is a desirable thing in the climate of Persia. If upper rooms are required, a greater strength of wall will be necessary. The mud is either laid on in layers or in the form of bricks.* In garden walls hollow bricks are used for the top, to give lightness. These bricks are called *sanduk*, a word meaning "box," which is de-

* Sun-dried bricks are called *khest* in Persian; the fire-baked bricks are *ajur* or *aujur*. In Afghanistan, *khist* is used for both burned and unburned bricks. *Gil*, with a hard *g*, is Persian for mud.

scriptive of their character.* The tendency in mud-building to produce thickness below in the walls, and lightness above, is most marked in the walls of villages and towns. These are all built with a visible batter. The earth taken out to form the ditch gives an abundant supply of material for a town wall, and a thick, solid mass at the base is necessary to give strength to the defense.

Where wood is plentiful, as in the province of Mazenderan, flat roofs are the rule. In large districts of Persia wood is scarce.

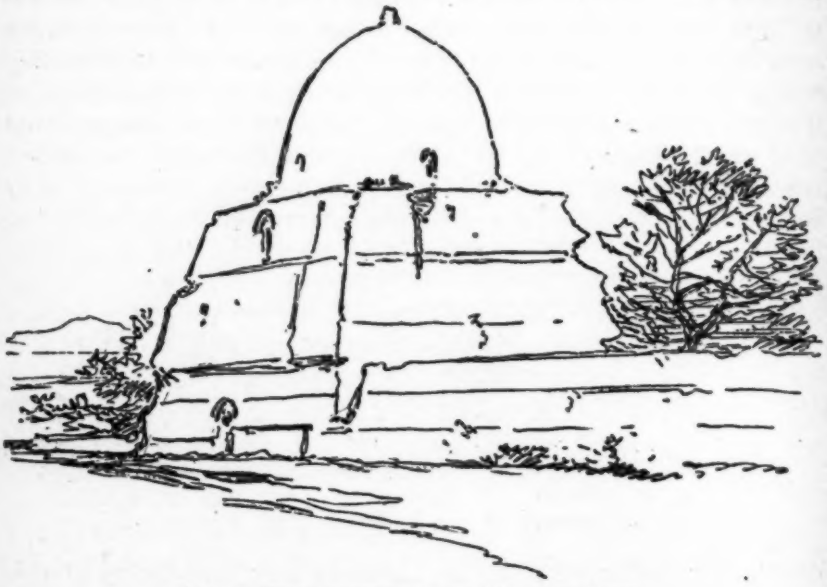

FIG. 3.—TOMB, CONSTRUCTED OF MUD, WITH DOME.

I understand that south of Tehran there is very little timber, and there is also great danger from the white ants, so the vault or barrel roof is the usual means employed. According to Strabo, it was the same in Mesopotamia; he says, "All the houses are vaulted on account of the want of timber." These vaulted roofs were frequent enough along the route I traveled. I have seen whole villages with them. Square buildings would have a dome; and a semi-dome at one end of a barrel-roof seemed to be a favorite method in that part of Persia. What struck me with surprise was the facility with which these villagers could construct such roofs. If there was any irregularity in the plan of the house, the barrel-roof was extended or drawn in, as the case might be, to cover the space. Of course, in the villages it was all a very rough-and-ready kind of work, evidently done by no better principle

* This recalls an old practice of Eastern architects, in constructing domes with pots, thus producing a considerable reduction of weight, and consequent diminution of thrust. A well-known example of this is the dome of St. Vitale, at Ravenna.

than that of rule of thumb. I was still more surprised when I learned that these vaulted roofs were constructed without centers.

In Persia the mud walls are covered over with a mixture called *kahgill*,* which is composed of mud and chopped straw; this serves to prevent the rains from washing away the walls, as it hardens the surface. The application of this mixture is generally repeated every two years.

The general impression in most minds will no doubt be that mud-building only belonged to a rude condition of civilization, and produced houses that were little better than hovels. I have now to point out that this manner of building was developed into a highly decorative style which in itself would entitle it to a place in the history of architecture. This position, it appears to me, has been almost entirely overlooked by those who have written histories of architecture. Architectural writers always treat upon primitive wood constructions, because forms can be traced from it up to the highly developed styles of Greece, Egypt, and India. The same process can now be gone through with the primitive mud as a building material. At present my purpose is to show that it was carried to a pitch of finish and refinement that

FIG. 4.—PERSIAN MUD VILLAGE.

rendered it worthy for the palace or the temple. The following letter sent to me by General Sir Charles Wilson would in itself be a sufficient evidence. Sir Charles is well acquainted with western Asia, and, being an engineer officer, he may be trusted as an authority. He says: "It may interest to you know that in Anatolia there is much mud-building; and that most of the great buildings of the Seljuks, more especially their great palace at Konieh, were of mud faced with glazed tiles. Some of the minarets of their mosques, built with sun-dried bricks, arranged in patterns and faced with glazed tiles, or with the ends of the bricks glazed,

* The word is *kah* = straw, and *gill* = mud. In Indian villages the mud floors are washed over with a thin mixture of mud and cow-dung.

are extremely beautiful in their decay. The Seljuk architecture is Persian with a development of its own." Here are mosques, or temples, and a palace constructed with sun-dried brick, which are declared by this high authority to be beautiful even in their decayed condition.

A somewhat similar development was reached in Peru, but with different materials. Squier, in his Land of the Incas, describes the palace of Chimu, where the *adobes*, or sun-dried bricks, were covered with stucco, on which beautiful arabesques were produced in relief.* From these ornaments he calls one of the great apartments the "Hall of Arabesques";* of which he speaks in warm admiration, and adds, "No description can give an idea of the character of these *rilievos*." In describing other ornamentation of the same kind, he says, "Here, as elsewhere, there are traces of color." †

I understand that the higher developed condition of this style of architecture in Persia was attained by covering the mud walls with glazed tiles. The tiles, it must be understood, were covered with ornament.

The interior of a mud building may also be decorated with glazed tiles; but in Persia *gatch*, or gypsum, is plentiful, and where ornament is required it is much used. In an old tomb, at Sarrakhs, I saw some particularly good ornament in this material; and it appeared to me to be all hand-work. I chanced to come upon one room that impressed me with the capabilities of this manner of decoration. It was at a place called Mazinan, on the first march eastward within the Khorassan frontier. There appeared to be the remains of more than one town here; I strolled over to that which was nearest, and found that it was all formed of mud. The mass forming the mound was artificial, for I found bits of red burned bricks or vessels imbedded in it. The top was a curious maze of rooms, courts, stairs, and roofs, much of it in a tumble-down condition. The solid mass of mud or earth was about twenty feet high, and the houses were above that; still, they were not all on the same level, for I went up and down short flights of steps. The whole was of mud or sun-dried bricks. The mud must have been carefully put on at first, but the high finish was produced by *gatch*, or gypsum. There were very handsome niches all round the walls, and the fireplace had been elaborate, but some act of destruction had taken place, and the fragments lay on the floor where they had fallen. The ornament was simple; there were some slight moldings on the space between the niches. Lines had been drawn into the gypsum, and an ornament

* Peru, or the Land of the Incas, p. 135.

† Ibid., p. 154; also at p. 411.

had been repeated by means of a stamp which had been pressed or imprinted when wet, producing a raised pattern; the impression left was so clean and perfect, it might have been gilt, and it would have been quite equal to the work we have at home on picture-frames.

Mud was the exclusive building material of that part of the world. The simple houses of the villages are formed of it; the defensive walls of the towns, which, owing to the Turkomans, were an absolute necessity to every village, were constructed of

FIG. 5.—THE MUD WALLS OF NISHAPUR, KHORASSAN.

the same. The houses of the rich were also formed with it, and it had been developed into a highly decorative style of architecture.

One would not expect much durability from such walls, yet I was informed that there are walls of sun-dried brick in Ispahan which are over three hundred or four hundred years old. This quality of durability will no doubt depend upon the character of the soil. In the northern part of Persia, according to Mr. A. Finn, of the consular service, the walls of the old city of Erig are still standing, and they are said to have existed for twelve hundred years. There still remains at Cacha, in Peru, a wall of *adobes*, or sun-dried bricks—part of the Temple of Viracocha, which was in a ruined condition about three centuries ago, when Garcilasso described it, and this wall is still standing to a height of forty feet.* There are the remains of very old walls in Egypt. There is a Devonshire saying regarding the "cob," or mud walls, of that

* Squier's Peru, p. 407.

locality, "A good hat and a good pair of shoes is all that cob wants." The pair of shoes here meant is a stone foundation such as I have described in the Persian houses — that is, to protect the lower part of the wall; and the hat is a sufficient amount of thatch, or covering, to the top of the wall to save it from the influence of rain. With such conditions, I believe that mud walls in Devon, even in our own damp climate, have stood for long periods of time.

The sloping jambs of doors and windows are peculiar to many old styles of architecture, such as the early Greek and Etruscan. Theories of origin for this have been often suggested, but we have no difficulty in accounting for them, if we suppose that the narrowness above was a form, and the natural result of the sloping walls of mud.

I have already explained how builders in mud—and which is well exemplified in Persia—construct their walls with a broad base, to give solidity below, and with a marked batter upward to reduce the weight above. It has been suggested—and, I think, with every reason in its favor—that this explains the very marked slope of the perpendicular lines of the Egyptian pylons. All the authorities agree in stating that in the old temples the outer wall forming the temenos of temples of Egypt was made of crude brick, and as the pylon was the gate through this wall in front of the temple, the great probability of its being constructed of the same material is obvious.

When I had seen village after village in Persia with vaulted or domed roofs, and learned that such roofs could be formed without centers, the idea immediately suggested itself that these methods of building had existed from the most primitive times. While the necessity for wooden centerings for building vaults and domes was believed in, we never could have credited an early state of civilization with this invention. Let this assumption regarding centers be removed, and the whole problem is changed. The earlier workers in mud or clay could not have been long in discovering how to spread their material over the space inclosed by four walls. They would, no doubt, have begun at first with small spaces, and a very little experience would soon have enabled them to deal with greater. If any one considers the matter, I think he must arrive at the conclusion that mud must have been first used for a long period of time before burned brick came into existence; and now that we know how easy it is to produce a roof with the mud, there is no great improbability in the assumption that the vault or dome, as well as the arch, all date back to a period when that material alone was in use.

I have described the foundations of a mud wall, such as they are in Persia, formed of burned bricks or stones and lime; and also

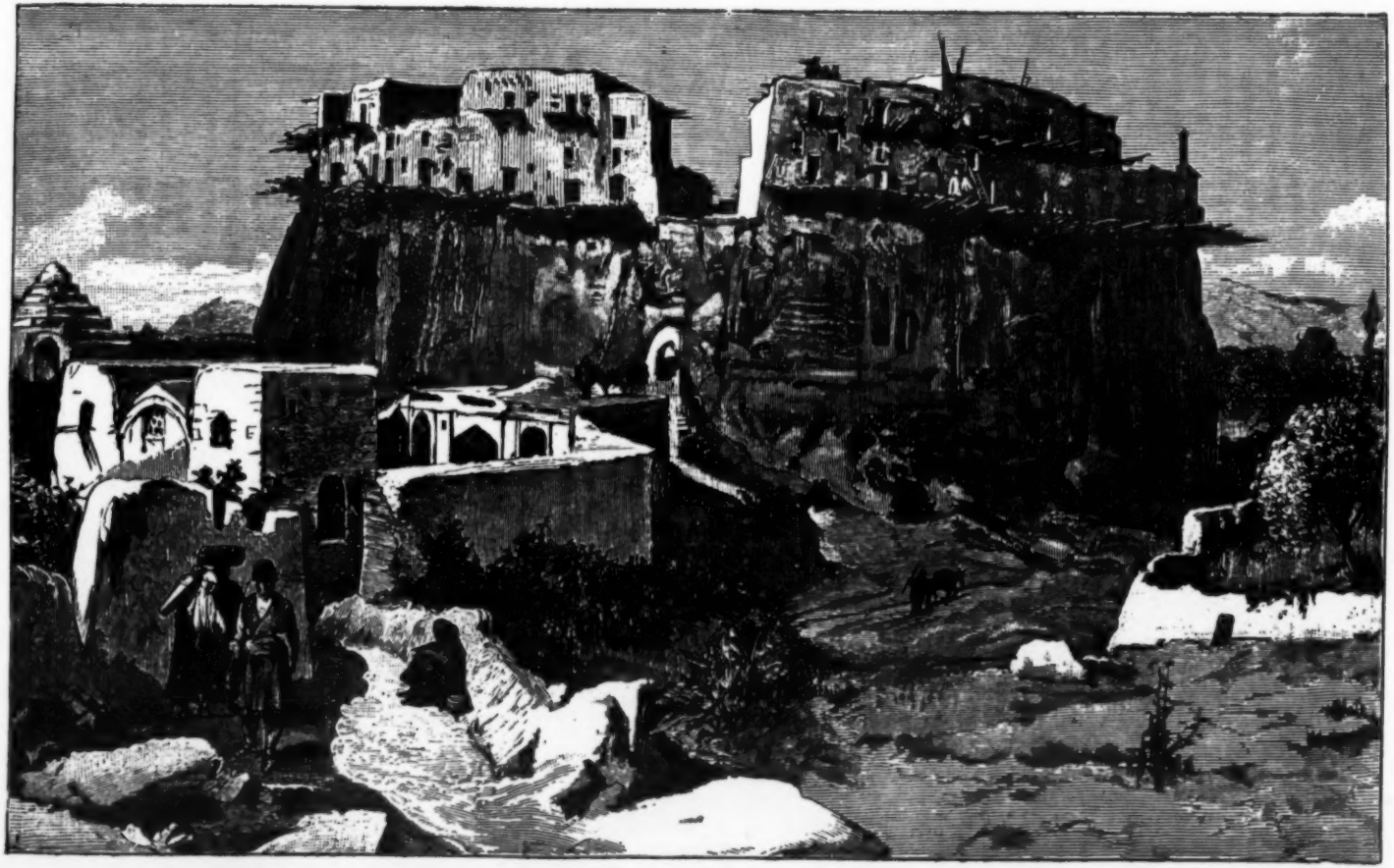

Fig. 6.—Lasgird.

in Devonshire, where they are known as a "good pair of shoes," because they protect the feet, or lower part of the wall. In the remains of the Temple of Viracocha in Peru the mud walls have a stone base eight feet in height. With these examples before us, and understanding the necessary purposes they served, we may assume that such protective substructures were generally employed wherever this particular manner of building was in use. It is highly probable that in this rude constructive detail we have the first origin of that part of the architecture in the palaces of Assyria to which the great winged bulls in the British Museum belonged. It seems now to be accepted that these palaces were constructed of crude brick, or at least this material was the principal one employed; baked or perhaps glazed brick may have been used in the exterior of the walls, but the interior was of sun-dried brick, and covered with stucco. This latter part is exactly what I saw in Persia. Along the base of these walls slabs of marble were placed, varying from three to about eight feet in height. These were generally sculptured, and the great bulls were represented on the portions of the slabs on each side of the doors. The development of this highly ornamental dado in the palace, from the base of the mud wall, is not a difficult problem to solve. The foundations I saw in the villages were formed of stones, half-bricks, or rubbish of any kind. In the better class of houses a more regular construction would be followed; and in palaces the covering of this with marble is what might be expected. I accompanied a visit of ceremony to the palace of one of the Shah's sons in Tehran, and I noticed that, in the room where we were received, slabs of alabaster, about three feet in height, went all round the base of the walls. These alabaster slabs in Persia are the counterpart of the marbles in the palaces of Assyria. In both cases they served the same purpose—they protected the lower part of the walls.

It was a source of some surprise to me to find that the Persian villages were, as a rule, exactly similar to those I had seen in the Khyber Pass and other parts of Afghanistan. They are square, formed with four high crenelated walls, and a round tower at each corner. The gateway is in the center of one of the walls, and the mud houses are huddled together inside, one might say, "anyhow." Larger villages may have six or eight towers; small towns or large ones have more wall and a larger number of towers. One of the first things that drew my attention to mud as a building material in Persia was, when in passing a small town one morning on the march, I saw some men either building or repairing the walls and towers of the place. It then struck me that these defensive walls were, with only some trifling details of difference, almost identical with the walls

we are so familiar with on the Assyrian sculptures. There is the same repetition of crenelated wall and tower, and constructed of the same material. I said to myself, "These men, in the pres-

FIG. 7.—STONE DOOR, LASGIRD.

ent day, are building an old Assyrian wall of fortification." Such defenses must have begun at a very early date in Mesopotamia, long before the sculptures were produced from which we know what they were in appearance, and their construction

has never ceased from that to our own time. This presents a very striking illustration of the continuity of type.

About one hundred miles east of Tehran, there is a curious village called Lasgird * (Fig. 6). It is supposed to be very old, and its circular plan is said to have been first drawn on the ground by Las, the son of Noah. The statement has already been made that the villages in Persia are square; such is the rule, and it will explain so far how a round one in their midst appears as something strange and remarkable. This great circular wall is so massive that the houses of the people are constructed on the top of it, and form in a rather irregular manner two stories. There are rude balconies, or I ought to say narrow ledges, on the outside which form communications. These are made of untrimmed branches of trees interlaced with twigs, on which mud is laid, but without a protective railing of any kind. The interior space formed by the circular wall is filled with store-rooms and places where the cattle can be safely housed in case of an attack from the Turkomans. The only entrance into this strange structure is by a small opening about four feet by three, which can be closed by a stone door turning on pivots. The smallness of this doorway was intended to prevent raiding enemies from entering during the chances of a rush, for it would be necessary to keep it open to the last moment to admit those of the villagers who were running home for protection.

I have dealt with this building material in the past; regarding its future I can say but little. In England here it was largely in use, so was wood, and that which is well expressed by the words "wattle and dab," which might be described as a combination of wood and mud. All these, as our material conditions have improved, have been slowly supplanted by the burned brick or stone. "Cob" is still in use, to a limited extent only, in north Devon. It may be assumed that it is not suited for our damp climate. In dry climates, such as Persia and Egypt, it is likely to continue, for the simple reasons that it is a cheap material, and that a comfortable dwelling can be made from it.†

I might mention a country like California as one where this material might be valuable. California has a dry climate. When I was in San Francisco, in 1873, that town was almost

* *Gird* in this word is said to have the same signification as "girdle" in English—which may be rendered as "circle."

† The author might have dwelt, to a greater extent than he has done, on the mud buildings of North America, which are abundantly exemplified in the *adobe* structures of Mexico, California, and New Mexico. As it is, he only refers to them incidentally. The log-cabins of our early settlers were of a mixed construction, in which the "dabbing" of mud played nearly as important a part as the framing of logs.—Ed.

wholly constructed of wood. Stone was feared, owing to the chances of earthquakes. While there, I visited the church of St. Francis, built of *adobes* a century before, and it had stood firm and secure all that time. It occurs to me—but I have no right to speak as an expert—that a house built of thick mud walls and wooden joists and rafters would be tolerably safe during an earthquake, unless it was a very severe shock; such a house would also be safer than a wooden one from fire, which has always been a great danger in San Francisco.

LANGUAGE AND BRAIN DISEASE.

By HOWELL T. PERSHING, M. Sc., M. D.

NOTWITHSTANDING the great number of persons engaged in learning and teaching languages, there is no general agreement as to what is the best method that can be employed. Indeed, there seems to be no belief that there can be one method which is best for both modern and ancient languages, for the pupil who must learn to converse and for him who wishes only to read. Nevertheless, there are well-ascertained facts concerning the brain, which point unmistakably to one method as the best. Hence, I have ventured to believe that all engaged in linguistic work would find it interesting and profitable to consider these facts, which, though far outside the linguist's usual field, are capable of throwing a strong light upon his work.

All the motions and sensations of the various parts of the body are represented on the surface of the brain as on a map. Thus, there is a separate brain area necessary for sight, another for hearing, another for the motions of the fingers, and so on. Each of these areas is called a center. Four of these are especially concerned in the use of language, and may therefore be called language centers: the auditory center, by which words are heard; the motor speech center, which excites and controls the vocal organs in speaking; the visual center, by which written words are seen; and the writing center, which guides the motions of the hand in writing. These centers are capable of individual development by practice, and, in order that each one may receive its due share of cultivation, it is necessary to know its relative importance in the different ways of using language.

Disease instructs us on this point by making some interesting though ruthless experiments. Inflammation, or the growth of a tumor, or the rupture or plugging of a blood-vessel, may destroy any of these centers, involving, of course, a loss of the corresponding function. Consequently, the various defects in the

use of language are the subject of a large and very important chapter in the treatises on brain disease. So far as I am aware no practical use has been made of this knowledge outside the domain of medicine. Yet it would be very strange if, from the ways in which the use of language is lost, or suffers varying degrees and kinds of impairment, we could learn nothing as to how it may best be acquired. The loss occasioned by the destruction of any language center is an indication of the defect that must result from neglecting to cultivate the same center by practice; and, as disease selects now one and now another center for attack, we

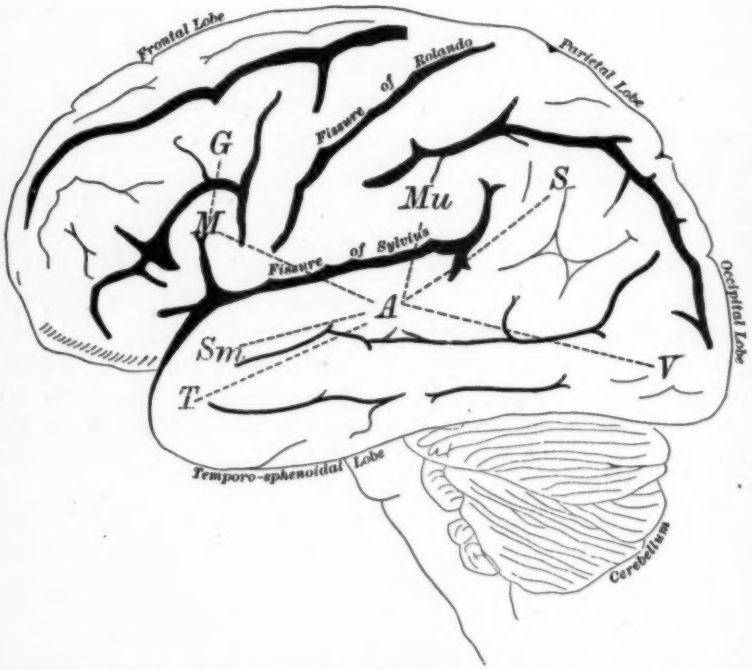

DIAGRAM OF THE LEFT SIDE OF THE BRAIN. (Modified from Ecker.) A, auditory center; M, motor speech center; V, visual center; G, writing center; Sm and T, probable centers for smell and taste (dotted because on inner surface); S, provisional location of areas for perception of touch, pain, and temperature; Mu, provisional area for muscular sense.

learn the extent to which each is necessary in hearing, speaking, reading, or writing.

In the accompanying diagram of the left side of the brain, the areas marked A, M, V, and G are the four language centers. The dotted lines indicate the paths of fibers which connect them with one another and with other centers, carrying nervous impulses somewhat as a wire carries an electric current. The corresponding centers on the right side of the brain are for the most part rudimentary, and may for the present purpose be neglected.

The auditory center, A, receives the nervous impulses started

by sound. When it is aroused by impulses coming from the ears, the sensation of sound occurs; but when it is aroused by nerve-currents, not from the ears, but from other parts of the brain, we have only the memory of sound. For a word to be understood, the auditory center alone is not sufficient. The sound must awaken the memories of other sensations. The word "orange," for instance, has a meaning because the auditory center, when the word is heard, arouses in the visual center the memory of the color and form of an orange; in the centers for touch, temperature, posture, and muscular sense, the memory of the sensations which occur when the fruit is grasped by the hand; in the centers for smell and taste, the memory of its peculiar odor, flavor, and tartness. These sensations are said to be associated with the sound of the word, and together with it they constitute the concept "orange." The nerve-currents passing from one center to another are called association impulses. If we have often eaten oranges, and at the same time heard the name, the auditory center whenever it perceives or remembers the sound will send vigorous impulses to the other centers, and the idea will be vivid. But if our experience of oranges has been very limited, or if the name has been rarely heard, or if instead of the correct name a merely similar sound has been heard, the association impulses will be sent slowly, feebly, and uncertainly, so that the idea will be vague. Prompt and strong associations should be cultivated as a means of securing clear and vivid ideas. The auditory center is the first language center to be developed. A child hears soon after birth, and toward the end of its first year the sounds of a few words are understood. Up to this time no words have been uttered, but the child now begins to imitate the sounds it understands and soon can use them. This requires the co-operation of the motor speech center, M, which by connecting fibers and the currents they carry combines the simpler movements of the vocal organs to form words. In the case of Gambetta, who was a loquacious politician and very successful orator, this center was excessively developed, though the brain as a whole was not remarkable. On the contrary, a study of the brain of the distinguished statistician, Bertillon, who was diffident and reticent, showed a high degree of general development, with an almost rudimentary motor speech center.

In speaking, the guidance of the *auditory* center is necessary. The sound of a word must be remembered when it is uttered. On the other hand, the effort of the motor speech center to utter a word reacts upon the memory of the sound, causing it to be more vivid. In the main the two centers work and develop together, but the auditory center is the more independent and fundamental. If a child becomes deaf, even as late as the tenth or eleventh year,

it also becomes mute, unless special educational measures are employed; and in adults destruction of the auditory center interferes sadly with talking, while destruction of the motor speech center does not seem to interfere at all with the understanding of speech.

When reading is first undertaken, the auditory and motor speech centers with their association fibers are already well developed. The visual center, V, now begins to work with them. When impulses from the eyes reach this center, the sensation of sight occurs. The appearance of each letter calls up the memory of its sound through the association fibers, V A, and a number of these elementary sounds uttered in quick succession are recognized by the learner as a word. Its meaning is awakened by the auditory center, and at first it is necessary to read aloud in order to make the association impulses from this center sufficiently exact and vigorous. Later, the memories of the sound and of its utterance suffice without its actual reproduction, but in most persons these memories remain an essential part of the reading process throughout life. As this is read, the reader is doubtless conscious of the sound and of the incipient utterance of each word.

In learning to write, the motions of the hand become automatically associated with the memory of the corresponding utterance. It might be supposed that in writing the appearance of each word is recalled and copied; but this is not the case, although the visual memory may be an aid to correct spelling. Words may be written with no recollection of their appearance.

The correctness of the foregoing statements is proved by the effects of disease of the language centers, as shown by observation of speech defects during life, followed by post-mortem examination of the brain.

Destruction of the visual centers of both sides causes blindness; but when these centers themselves are unharmed, disease may be so situated as to cut off their communication with other centers. In this case the patient sees, but does not recognize what he sees, and is said to be mind-blind. If the affection is so slight that he can still recognize ordinary objects, but not written or printed words, which are more difficult, he is only word-blind. To a person afflicted with word-blindness the print of his own language is like that of a foreign one. George Eliot, with her usual sure touch in medical matters, gives an interesting illustration of this affection in the case of Tito's foster-father, Baldasarre; yet Romola was finished in 1863, when very few physicians were aware of the existence of such cases. Reading in such a case is, of course, impossible; but writing is not prevented, although the patient can not read what he has just written. Speaking and the understanding of speech are not interfered with at all.

Destruction of the motor speech center causes a much more extensive interference with the use of language. The motions of the vocal organs being no longer co-ordinated, an inarticulate jargon, or the senseless repetition of a word or phrase, is all that is left of the power to talk. The ability to write is also lost. Reading aloud is, of course, impossible; but it is also a matter of common observation in such cases that the ability to understand print is lost or greatly impaired. This proves that in most persons direct associations between visual words and ideas, if they exist at all, are too weak to be depended upon. So the understanding of spoken words is the only way of using language that is independent of the motor speech center.

But it is destruction of the auditory center that causes the most extensive loss of language. In such a case words (though they may be heard through the right side of the brain) are not understood. This failure to understand is called word-deafness. But there are other serious defects. Although the vocal apparatus is in perfect order, and there are ideas seeking expression, the words uttered are mutilated, deformed, and often totally different from the ones intended, so that intelligible speech is well-nigh impossible. This shows that in talking the most important association impulses do not go directly from the centers for ideas to the motor speech center, but to the auditory center, which, remembering the sounds, by fresh impulses arouses the motor center to utter them. Writing is still more interfered with, because it depends upon the utterance-memory, which goes astray without the sound-memory.

Does destruction of the auditory center also prevent reading? We should expect it to do so, from the way in which reading is learned, and excellent authorities say that it does. There is not enough simple and direct evidence (consisting of the inability to read during life, followed by the discovery of disease limited to the auditory center after death) to prove this, on account of the small number of available cases and the lack of attention to reading in the observation of many of them. Making allowance, however, for the difficulties in the way of gathering direct evidence on this point, the cases published support the view that in most persons the auditory center is essential to the understanding of what is read. But there is other evidence that is quite convincing. We have seen that in reading the visual center can not, as a rule, call up the ideas, else destruction of the motor speech center could not interfere with reading as it does. Nor is the motor speech center directly connected with the centers for ideas; if it were, destruction of the auditory center could not interfere with talking as it does. This leaves only the auditory center, which is abundantly capable, for the sounds of words readily awaken ideas

before the other language centers begin to work and after they have been destroyed. Therefore, the auditory center must do the essential work of rousing ideas in reading. But if it does this, why is the motor center needed at all? We have seen that a beginner has to read aloud to stimulate the auditory center to do its work. In quiet reading the utterance-memory probably reacts upon the sound-memory, making it more vivid, and thus causing the auditory center to send out stronger association impulses. Possibly visual words first arouse a memory of the utterance instead of that of the sound, as I suppose. But, be this as it may, the facts clearly indicate that, in the evolution of language, the auditory center has acquired the position of a central station, through which the other language centers communicate with the centers for ideas. The sound of a word is the word itself. Printed words are only convenient symbols for recalling the sounds.

This gains in interest when considered in the light of Max Müller's views concerning the relation of language to thought. His motto is: "No reason without language; no language without reason." He contends that the scattered sense-memories can not be bound together to form a concept without a word, so words are essential to thought. He does not mean thought to include the inference that a dog makes when he sees his master start for a walk, or that which a driver makes when he sees a stone ahead of him and pulls the rein to avoid it. Undoubtedly such mental processes may go on without words. But it must be acknowledged that general or abstract thinking, such as places man so far above the lower animals, does require the use of words.

Now, what are the words that are essential to such thinking? Surely not visual words, but the words heard and uttered, as any one may know by attending for a few moments to his own thinking. And do not all the philologists tell us that the laws revealed by a study of the life and growth of language are phonetic laws?

Max Müller also alludes to the interesting distinction made by the German language in the two forms for the plural of *Wort*. *Worte* means living words actually engaged in conveying concepts from one mind to another; *Woerter* means words considered as mere objects. Visual words are only *Woerter*, dead bodies unable to support the burden of thought, mere effigies of the living sounds.

It is not meant, however, to deny the possibility of a different relation of the language centers to one another in abnormal or in exceptional individuals. Deaf-mutes may learn to read and even to speak, and doubtless to use visual words in thinking; but it is with much more than ordinary difficulty, and, in the opinion of some of their ablest teachers, the results are not so satisfac-

tory as to warrant the abandonment of the more primitive sign-language. And it is a fact of great significance that those deaf-mutes who have once been able to hear, though the subsequent deafness was total, have a great advantage over those deaf from birth, not only in learning to read and speak, but in general mental capacity.

We are now ready to apply our facts to the practical question of how best to learn another language than our own. One method, still prevalent in schools and colleges, attempts to extract the language almost by sheer force of memory from grammar and dictionary. It has never been claimed that by this method the ability to converse could be acquired, but it has been generally assumed that by it the pupil could at least learn to read, and perhaps, if diligent, to write to advantage. Yet, even for this purpose alone, the grammatical method must be a failure in so far as it neglects to train the pupil to a quick perception and a ready utterance of the sounds of the language, for we have seen that the auditory and motor speech centers do an essential part of the work in reading and in writing. Even if direct associations from the visual center may be cultivated, as in the case of deaf-mutes, why, instead of an easy and natural method, choose an unnatural and difficult one that leads to poor results? If it should be claimed that the grammatical method, without special attention to pronunciation, does enable pupils to read, and read well, in spite of any theorizing on the subject, then it must be said without hesitation that the claim is not warranted by facts. The remarkable unanimity with which the vast majority of our college graduates neglect to read the ancient authors is a very significant thing. It seems that they are not really able to *read* the Greek and Latin writers, but only to make a translation, and that they find no sufficient reward for this slow and irksome process.

As applied to the modern languages, the grammatical method is, even at its worst, supplemented by considerable exercise in pronunciation, and the ability to read with pleasure and profit is attained in a correspondingly higher degree. Yet, in estimating this ability, there is much room for self-deception. The pupil, after memorizing inflections and rules of arrangement, begins, with the constant use of the dictionary, to read, or rather, at first, to make a translation. Persevering, he finds that he needs the dictionary less and less, and perhaps he begins to understand without the use of English equivalents. Now, let us suppose that he has reached that point where he is able to read page after page without any absolute necessity of referring to the dictionary, or even of calling up an English word. Has he, as he is apt fondly to imagine, mastered the language as far as reading it is concerned? Not at all. He has made a respectable and useful acqui-

sition, but it is far from being perfect. Let him read a chapter of French or German, learned in this way, and then read the same amount of English—on the same subject, and, as nearly as may be, in the same style—and he will find a great difference in the time required. Let him read a plain narrative in the foreign tongue, and he will find that weariness importunes him to stop much sooner than it would if he were reading a good English translation.

Nor is this all. The meaning has been more or less misty throughout, as can readily be proved by taking the individual words out of connection and finding that many fail to call up any definite idea. And, although the ideas have appeared during the reading, they have been faint instead of vivid, because the association impulses have been sluggish and uncertain instead of prompt and true. Moreover, the subtile correspondences between sense and sound, which are allied to the unexplained power of music, together with almost all that constitutes the charm and effectiveness of style, have been lost in a struggle to get the bare meaning—no, not even the bare meaning, but a bare skeleton of the meaning. If this is a serious loss in reading plain narrative or scientific exposition, how fatal is it to the full enjoyment of poetical or rhetorical writings, where every word has been chosen with some reference to its sound! The readers of Hamerton's wise and charming essays on The Intellectual Life will remember how Tennyson's Claribel was read by a thoroughly cultivated Frenchman, who had long studied English and read abundantly of the literature, but had never become really familiar with English sounds:

"At ev ze bittle bommess
Azvart ze zeeket lon
At none ze veeld be ommess
Aboot ze most edston
At meedneeg ze mon commess
An lokez doon alon
Ere songg ze lintveet svelless
Ze clirvoiced mavi dvelless
Ze fledgling srost lispess
Ze slombroos vav ootvelless
Ze babblang ronnel creespess
Ze ollov grot replee-ess
Vere Claribel lovlee-ess."

Ought we to be content to read the French and German or the Greek and Latin poets in any such fashion?

But even such absurdly incorrect sounds serve some purpose, for they keep the association currents in their natural course through the auditory center. They are like a debased and mutilated currency, whose low and uncertain value discourages and

confuses trade, but which may, in default of anything better, still keep the stream of commodities flowing in the natural channels.

Now suppose a student, having reached the stage of progress above indicated, visits the country whose language he has been reading. What he hears at first is almost wholly unintelligible, though the same words in print would be familiar. A little later it is not uncommon to hear a sentence without comprehending it at all, when suddenly it will flash upon the mind of the hearer as though seen in print and pronounced by himself, and then it is readily understood. The same thing occurs in listening to one's native tongue when the auditory center has been slightly damaged by disease.

In these cases the damaged or unpracticed auditory center recognizes but a part of what is heard, but this is enough to suggest to the well-practiced visual center the complete memory of the visual words, which then calls up their usual, possibly incorrect, sound and utterance, with the associated meaning.

As time passes, the strange sounds, through constant repetition and efforts to imitate them, grow familiar and become strongly associated with every-day experiences, so that as soon as a word is heard the idea is vividly present in consciousness. If the student reads now, he finds his former disadvantages greatly diminished. He reads faster and with less fatigue, finding a clearness and vigor of meaning before unknown. It is not because his vocabulary is larger, but because it is more efficient. The auditory center, which formerly, through lack of practice, failed to properly perform an essential part of the work, is now, at the suggestion of the visual center, quick to recall each sound, and, re-enforced by the utterance-memory, it is quick, accurate, and vigorous in reviving each idea. The work of exchange is now done by the true coin of the realm.

The more carefully any teacher or thoughtful student will consider his own experience, the more he will be convinced of what the facts of brain disease demonstrate, that a good method of learning any language, whether the aim be to speak or only to read, must make the thorough training of the auditory and motor speech-centers a fundamental object. This training can be perfectly attained only by living where the language to be learned is spoken; but, although the difficulties at home are great, if the essential requisite is only kept in view, a great deal can be accomplished. This we owe to the clear insight and faithful work of the inventors of the natural method. Although this method is well known, it may not be amiss to give a sketch of how the best results may be obtained.

The first part of the course of instruction should be devoted exclusively to the sounds of the commonest words, their reproduc-

tion by the pupil, and the formation of strong associations between them and actual experiences.

The correct sounds must receive a degree of attention and reverence that would do credit to a music-master. Inevitable awkwardness in pronunciation should be corrected, not only by repeated efforts to imitate what is heard, but also by careful instruction as to the exact position and movements of the vocal organs in making the difficult sounds. This is of great importance, as it reacts upon the auditory memory and does much toward fixing a clear conception of the correct sound of each word. Probably very few Germans or Frenchmen have a clear conception of the sound of "*th*" in English; but had they from the first, whenever attempting this sound, been required to place the tip of the tongue between the teeth (which is never done in speaking French or German), there could be but little difficulty in pronouncing or recalling it. And in the same way a clear understanding of the fact that the French *u* and German *Umlauts* require the lips to be thrust forward and partially closed, will enable one to acquire these sounds far more readily than he otherwise could.

An *objective* expression of the meaning of words and sentences should always be sought. Things actually impressing the senses cause a more vigorous action of the brain than any recollection of them; consequently they make associations stronger and meanings more vivid. Although the exhibition of common objects and pictures, in teaching a vocabulary, may to the superficial observer seem childish and wasteful of time, it is in reality wise and economical.

The memorizing of sentences, reading aloud, listening to others read, and writing from dictation should all be employed, in addition to simple conversations between teacher and pupil, as valuable exercises. What is read at first should be carefully graded, so that the ideas may be awakened without having recourse to English, thus avoiding the habit of making a bad translation, which is often injurious to a school-boy's use of his own language.

As a pupil in the first stage of progress is pretty sure to go astray when left to himself, the work should be so arranged that all the time allotted to the language may be spent with the teacher. Tasks for outside preparation should not be assigned until the appreciation of the correct sounds is keen enough to prevent the contraction of vicious habits of pronunciation. Grammar should at first be taught only as it becomes available for immediate use; but, later in the course, it should be taught systematically, and copious outside reading should be assigned.

A student who can neither go abroad nor command the serv-

ices of a good teacher is at a great disadvantage; but he may still, if he has had a fair start, do much toward the cultivation of the auditory and motor memories of the foreign words with their proper associations, and thus greatly improve his ability to read. He should attend carefully to pronunciation, and practice reading aloud. When a new word occurs, the first thing is to get its correct sound, and the next to associate it with some actual experience, if possible; if not, then with as vivid an idea as can be recalled. The English equivalent must be dropped from consciousness as soon as the idea is present, so that the association may be a direct one. It is an advantage to use a dictionary with words and definitions in the same language. Reading on subjects in which one is specially interested is much better than general reading. The memorizing and frequent repetition of interesting passages will pay abundantly for the time and trouble.

The great difficulty in working alone is to hear enough of the language to keep the auditory center familiar with its correct sounds. To this end, every opportunity should be taken to converse, or to hear a sermon or a play, in the foreign tongue. In many American cities such opportunities are not rare, especially as to German.

For this purpose the phonograph will no doubt be made of great service. With its aid choice passages in literature or scientific exposition, as rendered by a good reader, can be repeatedly heard and pronunciation and accent imitated at the pupil's convenience. I have no doubt that some process of cheaply multiplying the phonographic cylinders or ribbons will, before very long, enable us to enjoy whole books in this way, thus saving our weary eyes and economizing the energy of the brain, while giving a greater pleasure.

I see no reason why Latin and Greek may not be taught to advantage by some such method as the one that has been outlined. The uncertainty as to what the original sounds were, though embarrassing, is not nearly so great as one would naturally suppose. Philological science has reached such perfection that at least a close approximation to the correct sounds could be agreed upon and registered by the phonograph.

As Hamerton suggests, a phrase-book could doubtless be made for teaching each language by the natural method. A student once fairly started in this way could not fail to make greater progress in grammatical and philological knowledge, as well as to find the classical authors more interesting.

In conclusion, it may safely be said that the reader who has given his assent to the deductions here made from the facts of disease will not hesitate to go further and concur in the opinion that pedagogy will in the future find a scientific basis in a

knowledge of the functions of the brain. Its career must somewhat resemble that of the art of medicine. There were great physicians before Harvey found a starting-point for scientific physiology; yet the debt of practical medicine to physiology is now well-nigh incalculable. So it will be with the art of teaching: noble work has been donè for its advancement in entire ignorance of the organ whose best development it seeks; but now, since there is already a large and constantly increasing fund of knowledge concerning the working of the brain, teachers who are not bound to the traditions of the past, but are looking eagerly for every means of improving their art, will assuredly not fail to take advantage of the new knowledge.

The result must be an enormous gain for the children of the future.*

An influence of a total solar eclipse on air pressure has been deduced by Herr Steen from the comparison of the records of fourteen Norwegian ships between Panama and Madagascar, during the eclipse of August 29, 1885, four of the ships having been within the zone of totality and four others very near it. Two maxima of pressure, separated by a minimum, were revealed. The double wave is explained by Herr Steen by assuming that during a solar eclipse day is changed to night for a short time, and the transition is much like the ordinary change from day to night in the tropics, where the twilight is short. There the curve of air pressure has regularly a maximum about 10 P. M., some time after sunset, and a minimum about 4 A. M., shortly before sunrise; while a second maximum appears about 4 A. M. A total solar eclipse would naturally act in a similar way.

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* References.—Any reader interested in the foregoing argument would do well to verify the statements of fact on which it is based by reference to some of the following well-known authorities:

For a very clear, popular account of the functions of the brain, see Prof. M. A. Starr's article, The Old and the New Phrenology, Popular Science Monthly, October, 1889.

For a more complete account, consult the same author's Familiar Forms of Nervous Disease; Gowers's Diseases of the Nervous System, pp. 454–465, American edition; and the text-books of physiology by Michael Foster and by Landois and Stirling.

For defects in the use of language, besides the above, see Th. Ribot, Diseases of Memory, chap. iii; Moebius, Allgemeine Diagnostik der Nervenkrankheiten; Ross, Diseases of the Nervous System, chap. xviii; H. C. Wood, Nervous Diseases and their Diagnosis, chap. ix; Gowers, *loc. cit.*, pp. 540–555; also Starr, The Pathology of Sensory Aphasia, Brain, July, 1889, and Apraxia and Aphasia, Medical Record, October 27, 1888.

For a discussion of word-blindness and mind-blindness, illustrated by cases of great interest, see Charcot, Leçons sur les Maladies du Système Nerveux, tome iii, pp. 154–189.

For a discussion of the working of the brain in reading, with references to previous researches, see Ein Beitrag zur Lehre von den Lesestoerungen, Weissenberg, Archiv f. Psychiatrie, xxii, 2.

The most philosophical and elaborate work on the disturbances of speech is that contributed by Kussmaul to Ziemmsen's Cyclopædia, vol. xiv.

In consulting any author on this subject the date of writing must, of course, be considered, as every year adds materially to the common store of available facts.

A CHAPTER IN METEOROLOGICAL DISCOVERY.

By JOHN COLEMAN ADAMS.

ONE of the most interesting phases in the history of scientific research is what may be called the co-operative feature. No great machine is the invention of one mind. Few great discoveries have been made in complete accuracy by any one man. A locomotive is a mosaic of inventions, discoveries, and improvements. It would be impossible to estimate the number of minds which have contributed to the mighty structure, and have slowly built up its complex perfections. The names of Stephenson, Jervis, Winans, and Allen, in their successive contributions to the devices by which the locomotive has increased its capacities, but faintly hint the immense number who have given some detail, some great or small modification and improvement by which the vast and impressive result has been built up. In the same way, every science grows to its completeness by the accumulating discoveries of individuals, added from year to year and century to century. Astronomy has gathered its harvest of results by the hands of hundreds of patient toilers. Copernicus established the true center of the solar system; Kepler added the three great laws which bear his name, relating to the orbits and the periods of the planets; Newton contributed the law of gravitation. The science has been a growth, fed by the thoughts and the painstaking labors of many minds. And while each of these great men has furnished a distinct and complete contribution to the total knowledge in the science, each has also depended upon his predecessors for co-operation and the data which made his own task possible of accomplishment.

Just such a process as this has been going on in the young and growing science of meteorology. It may be doubted if any other branch of science in our century furnishes a more curious and valuable illustration of the progress of discovery in a given field, the corrections applied by later discoverers to the work of their predecessors, the accumulation of facts and data till they are sufficient for the formation of a working hypothesis, the modifications of the hypothesis in the light of new data, the application of the theory to practical affairs, and the unification of the set of phenomena thus investigated with other and all facts in the same branch of science. The history of the investigations which created our great system of observation and record, and made it possible for a whole people to get daily bulletins of the morrow's probable weather, is one of the most striking in the whole history of science. Let us sketch it as it lies in the annals of the learned societies of America, as yet both uncollected and unconnected.

It will be seen how discovery started from a casual hint based on the observations of a keen and well-trained mind; how it was stimulated in a later observer, who bent himself to the painstaking collation of facts bearing on one special set of phenomena; how these facts finally warranted him in advancing a hypothesis; how this hypothesis was opposed and criticised; how it maintained itself in the face of increasing light; how more extended observations confirmed it and enlarged its application; how it became the basis of all subsequent investigation; how it was sustained by the testimony of other observers working along similar lines; and how to-day it is at the very corner-stone of the meteorological science in America. To this narrative let us turn.

It may be fairly presumed that the well-known suggestions of Benjamin Franklin, based on the occurrence of a northeasterly storm in Boston shortly after one was noted in Philadelphia, was the first definite contribution to the scientific knowledge of North American storms and their movements of transition. Though that contribution was little more than a speculation, it was nevertheless one of those sagacious anticipations of results which marks the true scientific genius. In a letter to Jared Eliot, dated at Philadelphia, July 16, 1747, Franklin says: "We have frequently along this North American coast storms from the northeast which blow violently, sometimes for three or four days. Of these I have had a very singular opinion for some years—i. e., that though the course of the *wind* is from northeast to southwest, yet the course of the *storm* is from southwest to northeast; that is, the air is in violent commotion in Virginia before it moves in Connecticut, and in Connecticut before it moves at Cape Sable." In another letter to Eliot, dated at Philadelphia some two years later (February 13, 1749–'50), Franklin says: "You desire to know my thought about northeast storms beginning to leeward. Some years ago there was an eclipse of the moon at nine in the evening which I intended to observe, but before night a storm blew up at northeast and continued violent all night and next day; the sky was thick clouded, dark, and rainy, so that neither moon nor stars could be seen. The storm did a great deal of damage all along shore, for we had accounts of it in all the newspapers, from Boston, Newport, New York, Maryland, and Virginia. But what surprised me was to find in the Boston newspapers an account of an observation of the eclipse made there, for I thought as the storm came on from the northeast it must have begun sooner in Boston than with us, and consequently prevented such observation. I wrote to my brother about it, and he informed me that the eclipse was over there one hour before the storm began. Since which I have made inquiries, from time to time, of travelers and of my correspondents to northeast and southwest, and

observed the accounts of newspapers from New England, New York, Maryland, Virginia, and South Carolina, and I find it to be a constant fact that the northeast storms begin to leeward, and are often more violent there than to windward."

Those letters are probably the earliest literature on the subject of North American storms, the first documents of scientific value in the long series of observations and of studies which have brought us to our present valuable knowledge. Undoubtedly, this fact, which had suggested itself to Franklin, had been observed before by fishermen, by mariners, and others, accustomed to the practical observation of the weather. But this is the initial point of its treatment as a scientific phenomenon. Between the two kinds of observation there is a world-wide difference. The observer is not always nor often the seer. There are a hundred thousand who can note a fact for one who can draw an inference from it. A good many myriads of generations had noted the ebb and flow of the tides before anybody noted a connection between these facts and the daily passage of the moon across the meridian. It is likely that a good many fishermen and sailors and captains had talked over the curious fact that the first signs of the coming northeaster seemed to be from the leeward of its characteristic wind. Perhaps some of these unscientific folk had propounded their crude theories about the motions of storms to the little knots of comrades about the cabin fire or under the forecastle's dim lantern. But, being unscientific people, they did not know how to gather and marshal their facts, draw their inferences, and declare their hypotheses. And so Dr. Franklin must have the credit of first propounding this doctrine about American storms. Many years elapsed before his became the accepted view, and people understood that the easterly storms of New England, and indeed of the whole country, were travelers from west to east, and not visitants from the sea, drifting up the coasts and inland. The lack of facilities for observation, the dearth of data, the infrequency of communication, the almost utter neglect of the phenomena whose study in recent years has founded the science of meteorology, were all conditions which greatly retarded the knowledge of meteorology in our own country, and made it impossible to trace the connection of weather in one region with that in others.

WILLIAM C. REDFIELD.—The serious and consecutive study of the motions of North American storms may be said to have begun with the investigations of William C. Redfield, one of the most painstaking, broad-minded, and sagacious of American scientists. So competent an authority as Commodore Maury has called him "the Kepler of storm physics." Prof. Denison Olmstead, of Yale College, in a brief memoir published in the American Jour-

nal of Science (vol. lxxiv), says: "The honor of having established on satisfactory evidence the rotary and progressive character of ocean storms, and determining their modes of action and laws, it is due alike to the memory of the departed and the credit of our country to claim for William C. Redfield."

Redfield was a Connecticut man, born at Middletown in 1789. He was a naval engineer, and, besides his valuable contributions to this science, he was much interested in various other branches, and especially in the problem of increasing the speed of steamboats. Olmstead declares him to have been the first man to suggest a great railway system between the Hudson and the Mississippi.

It was in the year 1821 that Redfield began the study of what he called "Atlantic storms." He was led to it by a casual circumstance, like that which called out Franklin's hint as to the direction of the movement of these storms. And let it especially be noted, as the story of his investigation is told, how clearly that story teaches the value of close and patient study along some single line of facts, until their relations are laid bare and their meaning uncovered. Redfield is an illustration of the value to the world of men who know, not a great many things a little, but a few things a great deal.

In the year 1821 a severe storm prevailed along the Eastern coast, which for many years was known as the "great September gale." It held that title until September, 1869, when another and more remarkable one occurred, which rather disturbed its claim to the honor. It was a little time after this first storm that Redfield, while making a journey in Massachusetts, was struck by a somewhat curious fact. He noticed that in Massachusetts the trees prostrated by the wind, all lay with their heads to the southeast, showing that the gale there was from the northwest; but in Connecticut the trees blown down in the same storm lay head to the northwest, showing that the gale had been a southeast one. He ascertained, moreover, that when the wind was blowing southeast in Middletown, his home, it was northwest at a place not seventy miles from there. It was then that the idea flashed across his mind that the gale was a progressive whirlwind. That was a great thought. It was such a flash of perception as came to Newton when he connected the falling apple with the planets in space. It was such an insight into the meaning of a fact as James Watt had when he saw the possibilities of the force that was rattling the lid of the kettle on his mother's fire. The development of that idea was destined one day to put Redfield in the ranks of the great scientific thinkers of his day. He made this storm the basis of his investigations, following his researches into its movements by a careful collection of facts in relation to others like it. For ten years he studied, and examined and com-

pared his facts, before he published his theory of storms. He noted the occurrence of several great gales, and set about collecting all the facts possible in reference to them, carrying on a wide correspondence, and examining a multitude of witnesses. He sought out the marine reports as to all vessels coming into port soon after the storm, examined their log-books and talked with their captains. In the case of the great Cuban hurricane of 1844, he collated one hundred and sixty-four different accounts. He noted the latitude and longitude of the vessels at sea, or the observers on the coast, when they took the gale, the direction and force of the wind as they experienced it, the direction in which it veered, the states of the barometer, and all cognate facts. Then he charted the whole and studied its meaning.

It was in 1831, ten years from the time in which he first observed the effects of the September gale and drew his inferences from them, that he published an article, "On the Prevailing Storms of the Atlantic Coast." In it he gave an account of the gale of 1821, which he describes as "exhibited in the form of a great whirlwind." He had now made several important conclusions in reference to this class of storms: 1. He held that they often originate in the tropical latitudes, frequently to the north and east of the West India Islands. 2. That they often cover at the same moment of time an area of from one hundred to five hundred miles in diameter, and that they are most violent nearest the center of this area, and least energetic about the exterior lines. 3. That while in the tropics these storms move from east to west till they reach the parallel of 30° north, when they suddenly recurve to the north and east, and move rapidly along lines generally parallel with the Atlantic coast of the United States. 4. That the direction of the winds along the greater portion of its storm-tracks *is not the same as the direction of the storm itself.* 5. That when in these northerly latitudes these storms, while moving in a northeast course, begin with a wind from east to south, and terminate with a wind from west to north. 6. That on the outer portion of the track, north of the parallel of 30° or within that portion lying farthest from the American coast, these storms exhibit at the commencement a southerly wind which, as the storm comes over, veers gradually to the westward, a quarter where it is found to terminate. 7. In the same latitudes, but along the central portion of the track, the first force of the wind is from the southeast, but after blowing for a certain period it changes suddenly to a point nearly or directly opposite. 8. On that portion of the track nearest the American coast or farthest inland, if the storm reaches the continent, the wind commences from an east or northeast point and veers more or less gradually by north to northwest.

This was certainly a very important series of conclusions, and it establishes certain principles or laws in regard to a certain class of North American storms beyond cavil. Redfield had thus shown that many at least of the great storms which traverse the Atlantic coast come from the tropics east of the West Indies and describe a great parabola in their course; that the direction of the wind in these storms was entirely a distinct matter from the direction in which the storm is moving; and that this storm is a system of winds, blowing whirlwind-fashion about a central point, in a direction contrary to that of the hands of a watch. That is the substance of Redfield's discovery; and it is one of the most important contributions ever made to the science of storms, not alone in its purely scientific relations, but also, as we shall see, in a most practical way in the service of mariners.

Just here we touch an interesting episode of Redfield's career, in his connection with Sir William Reid, an English engineer-colonel at Barbadoes, himself deeply interested in this subject, and an investigator of the law of storms in general. Redfield and Reid entered into a correspondence upon the subject which lasted for twenty years, and which Redfield declares was most serviceable to him. But, as Colonel Reid's earliest inquiries were based on a storm of 1831, ten years later than the one which gave Redfield his first hint of a theory, it may still be maintained that Redfield was the first to grasp the new facts in all their meaning. He acknowledges an indebtedness to Colonel Reid as well as to Piddington, in his essay on "Asiatic Storms." But their work could have done little more for him than to confirm his own thought and guide his investigations. It remained for this early student of these phenomena to follow the great storms of the Atlantic from their breeding-place near the "doldrums," in their curving path through the Gulf of Mexico and along the United States coast, proving that these vast hurricanes of the West Indies are progressive storms, moving westward till central in the Gulf and then recurving toward the northeast, retaining their essential characteristics, though somewhat less violent than in their beginnings. This was the scope of Redfield's investigations. He indicated the track of one entire class of American storms, and showed them to be great circular movements of the air, like immense whirlwinds or cyclones, traveling bodily over wide areas.

A word more ought to be said before we pass from the work of Redfield, as to his theory of the direction of the winds about the center of a cyclone, a point much debated since his day, and in which he was singularly correct in his judgment. At the time he made his investigations, everybody supposed that these great storms were disturbances in which the winds blew

straight away from one point of the compass; and one of the theories advanced in opposition to this, held that the winds in these systems blew radially in to a common center. Redfield, however, maintained that they blew neither radially toward the center, nor yet in circles around it, but as water or smoke in a vortex, with a constant inclination to the center. Here, too, he came very close to the most commonly received doctrine of this present time; and it proved in entire harmony with the law propounded by Ballot—a law which may be thus expressed: "The wind which blows around an area of low barometer, blows neither in circles returning on themselves, nor directly toward that point; but it takes a direction intermediate, approaching, however, more nearly the direction of circular curves than of radii to a center." Redfield's researches also showed that the winds about a low-pressure space blow in a direction contrary to that of the hands of a watch.

One fact more should be stated in reference to the nature of Redfield's work and its practical value. Few discoveries in science have ever been turned more quickly to the benefit of mankind; for one of Redfield's first undertakings, after establishing these laws of the great Atlantic storms, was to formulate certain rules for the management of vessels during these gales, by which the heaviest force of the storm may be avoided. One of the completest answers to the skeptical queries of matter-of-fact people as to the utility of purely scientific studies, is found in the fact that the outcome of Redfield's studies as attested by United States naval officers like Commodore Rodgers and Lieutenant Maury, was an immediate service to ship-masters in showing them how to avoid the heaviest parts of a cyclone, and save their vessels the risk and the wear and tear of an encounter with the violent winds of the storm-center.

JAMES P. ESPY.—But we must leave the work of Redfield, important though it was, and move on, in fulfillment of our purpose, to note the contributions of those other men who helped to complete our knowledge of great American storms.

In the year 1850, Prof. James P. Espy, one of the most original and talented of American meteorologists, published his conclusions in regard to the character of American storms, which must be regarded as the next step in the enlargement of our knowledge on the subject. His views were presented in a work entitled The Philosophy of Storms, the fruit of earnest and painstaking studies. The great feature of this work was its presentation of a new class of storms. Espy directed attention to those great atmospheric disturbances which no one hitherto had dealt with, which move across the continent from west to east and which do not originate in the West Indies. Redfield's

attention was confined to his favorite West Indian storms, which travel *via* the Gulf of Mexico. Espy reminded the public that these were not the only great storms which visit the United States. "There are rain and snow storms," said Espy, "which from November to March, at least, travel from west to east. These storms are first heard of west of the Mississippi and sometimes as far north as Iowa; and they often travel from the Mississippi to the Connecticut in twenty-four hours." He concluded that these storms must originate in the far West, at that time only a wilderness, and so beyond the outposts of observation. Espy did not assert that these storms differed in character from the ones with which Redfield had dealt. He only reminded the world that the West Indies were not the only place where storms were generated. In so doing, he accurately pointed out the origin of a large proportion of American storms. The storms which Redfield studied were really the least, in point of numbers, among the storms which visit the continent. But Redfield's observations were confined to the seaboard, so that he necessarily did not have his attention drawn to this second class of great storms. Like many later Eastern men, he did not realize what a prominent part the West plays in the economy of the country.

In two respects Prof. Espy became the critic of William C. Redfield. He held that the winds related to great storms blow radially to a center, either obliquely or directly. He also believed that the depression of the storm-center was caused, not by the centrifugal force generated by the motion of the winds, as Redfield was inclined to maintain, but was on account of the rarefaction of the air through the heat developed by the condensation of vapor in the form of rain or cloud. The latter theory proved of more value than the former, and will stand as one of Prof. Espy's additions to the meteorology of North America. The Western origin of many storms and the function of heat in the development of cyclones—these are the two contributions of Espy to the science of American storms.

PROF. HARE.—But Espy's eyes were not sharp enough to see all the facts about the origin and movement of our great disturbances; and so, as he made certain suggestions which added to the value of Redfield's discoveries, his own in turn received amendment. The chief of Espy's critics was that eminent American scientist, Dr. Hare, whose queries in regard to Espy's conclusions were pertinent and searching. He asked, among other things, "whether agreeably to the observations of Franklin and general experience confirming them, our storms producing northeasterly winds do not travel from southwest to northeast; whether their traveling thus does not warrant the opinion that they originate in the Gulf of Mexico; whether the observations of Redfield do

not establish the fact that certain storms travel from the Gulf along the coast; how the observations of Franklin, confirmed by the general impression that they were sagacious, can be reconciled with those made by Loomis (locating the place of origin of some storms in the Northwest of the United States), unless there be two kinds of storms, one of which travels from southwest to northeast and the other from northwest to southeast; and whether it can be correct to confound these two kinds of storms under one generalization—i. e., storms moving from east to west." Of course, these slight strictures did not seriously affect the validity of Espy's conclusions, any more than they added materially to the sum of Redfield's. They simply helped to bring all the facts now discovered into relation, and take the emphasis off any especial class, the peculiar study of individuals. They show how valuable are all individual contributions to the growth of a science, and how, when there is a number of observers in any one field, each may be a check upon the others and supplement their defective data or inferences. Redfield discovered the origin of one class of storms, and laid down the laws of their movement and internal motions. Espy pointed out a new point of origin of storms, and threw some new light on their internal winds. Hare pointed to still another quarter whence these great whirlwinds arise, and directed attention to the various tracks which they pursue; and the investigations which led to these results extend over a term of perhaps thirty years, from the year 1821 to 1851.

ELIAS LOOMIS.—It was about this period that Prof. Loomis, of Yale College, was prosecuting his studies in meteorology, and especially in regard to storm-motions, which have since become a valuable part of our knowledge. He was a later worker in this field, and his labors were made the more valuable from the fact that the country had been growing rapidly, especially toward the Northwest, and he was thus enabled to command much new material in the way of observations from this quarter of the country, which had not been available for the others. Loomis found that great storms, of like character to those reported from the southwest and the Atlantic coast, also swept the northern parts of the country, with identical details, in respect to winds and motions. These were included in his studies, and thus the generalizations in respect to our storms were greatly enlarged. Perhaps the gist of Loomis's conclusions in this matter is condensed into this paragraph from his Meteorology, which, by the way, was the first treatise of any pretensions upon this subject published in this country. He says: "The average direction of storm-paths across the United States is toward a point nine degrees north of east, but it varies somewhat with the season of the year, being almost exactly east in summer and inclining more to the north in the

winter. Occasionally storms depart very much from the average track, their course being sometimes directed toward the southeast and sometimes toward the northeast, and occasionally their course for a day or so has been almost exactly north. Their average velocity of progress is twenty-six miles per hour, being twenty-one miles in summer and thirty miles in winter; but sometimes they attain a velocity of fifty miles in an hour, and sometimes they remain for a day or two sensibly stationary."

BLODGETT, MITCHELL, COFFIN.—Several other names deserve mention, as belonging to earnest investigators and theorists in the early fields of American meteorology. Loren Blodgett, M. N. I., published in 1857 a work on the climate of the United States, far superior to anything previously sent out. About the time of Redfield's earlier work, Prof. Mitchell, of the University of North Carolina, propounded a theory which seems to have attracted but little attention—as indeed it deserves but little—maintaining that certain storms, especially those of the Atlantic coast, are the result of a gyratory motion about an axis parallel to the plane of the horizon. This proposition he held in opposition to Redfield, whom he mentions as contending for the revolution of the wind about an axis perpendicular to the plane of the horizon. This speculation of Prof. Mitchell was of less value to science than his suggestion of the plan of daily maps, showing the aspects of the sky, that cloud boundaries might be traced, and thus their extent and movements discovered—an idea which is incorporated into the every-day work of the Signal Service at Washington. Still another of the meteorologists of service in the line of investigation we are describing was Coffin, the author of Studies in the Winds of the Northern Hemisphere.

DR. JOSEPH HENRY.—When the study of the laws of storms and their movements in America had gone as far as this, it had reached a point beyond which it could not proceed without a more abundant material in the way of observations and statistics. More data were required, if larger demonstrations were to be made. The time had come when no great advance in the knowledge of storms could be had, unless they were carefully studied over large areas, their actions noted at a great number of points at once, and the information thus gained reduced to order. Of no other science is this so true as of meteorology; of no branch of meteorology is it so true as the observation of storms. Eternal vigilance is the price of all knowledge in this great field. And we are now at a point in the progress of the study of American storms when a great advance was made. Prof. Joseph Henry, the Director and Secretary of the Smithsonian Institution, and one

of the very foremost of American physicists, put into execution a plan long conceived and long agitated, securing a system of daily observations throughout the United States and Canada. He first arranged for daily reports by telegraph, and was the first to have the atmospheric conditions over a large territory indicated on a map. He paved the way for the systematic researches of that department of the public service which has since been organized as the Weather Bureau, established in 1870, the most important work in the interests of this science which has ever been undertaken. For it is now possible to put in the hands of a few trained minds at Washington, three times in every day, an amount of data many times more than all that Redfield or Espy or Hare collected in years of study. It is to the efforts of Dr. Henry, following upon the patient research of the men whose work we have thus slightly traced, that we owe the rise and growth of the science as it stands to-day. An army of observers, drilled to the greatest precision of scrutiny, on land and on sea, on hill-tops and in the valleys, in every latitude from the equator to the polar circle, scans the heavens and watches the earth for every meteorological change. The charting of great storms, the making of forecasts, the posting of storm-warnings, all indicate the condition which this science has slowly attained, through the combined and cumulative labors of so many patient observers. From the conjecture of Benjamin Franklin, about the northeast storms beginning to leeward, to the splendid system by which the movements of a great storm are announced and described almost as regularly and clearly as the movements of trains on a railway system is a long advance. It is an advance which shows how much we have to be proud of in this great national work, as it has grown and developed at the hands of our own countrymen. It illustrates, moreover, the fact that in the researches of science, as in all the labors of humanity, every man's work tells, and enters into the great result. Patient toil concentrated upon chosen subjects never fails to yield its due results, valuable for all men. Even the most abstruse scientific research may have, nay, will surely have, its issue in practical good to men; and the most retiring and isolated student in his solitary studies is as true a servant of his kind as he who sows and reaps acres of wheat, or weaves the cloth that clothes men's bodies. When William C. Redfield was gathering the facts about his Three Great Atlantic Storms, he was doing as direct a service to the future shippers and navigators of the Atlantic coast, and the cotton-growers of Georgia and Alabama, as if he had furnished cargoes for their ships or markets for their cargoes.

A COMPARATIVE STUDY OF SOME INDIAN HOMES.

By R. W. SHUFELDT, M. D.

WHILE attached to a military expedition against the Sioux in Wyoming in 1877, I saw those Indians construct at the various camps we made what I take to be the most primitive form of house built by human hands. It was simply a shelter, or *tepee* as they called it, made with the green boughs cut from the cottonwood trees. Without any especial preparation of the ground, they implanted the cut ends of the limbs in two parallel rows about eight feet long and five feet apart. The tops were adroitly bent over the inclosed space and fastened together along the middle line, thus creating a semi-cylindrical shelter open at both ends. These *tepees* were merely intended for two or three men to sleep in, all the cooking and other arrangements being performed outside.

In permanent summer camps these *tepees* are built in a subhemispherical shape, the ground upon which they are erected being previously cleaned off, moderately scooped out, and the earth thus obtained banked around the in-stuck ends of the boughs on the inside of the structure. They are then trimmed up and properly covered outside with long prairie grass, so placed as to shed the rain. Often, too, they threw an old buffalo-hide over the top as an additional protection.

In 1886 I observed the Navajos in northwestern New Mexico building similar houses to the ones I have just described; but those Indians also build a more durable structure in their *hogan* —a conical house of logs plastered with mud, and with a door at the side. Navajos, too, are improving in their home-building, more especially where they have taken up their abode in the neighborhood of frontier military garrisons. All this I have explained in a paper read before the Anthropological Society of Washington (March 17, 1891), and which appeared in the Proceedings of the United States National Museum.*

Many other Indians build these temporary shelter-houses, and among them the Apaches of Arizona. In Fig. 1 of the present paper they are well shown as they are constructed by those Indians in a summer camp. Here they have protected the top by large pieces of old canvas, thus making one of them quite waterproof. Corbusier, in the September number of the American Antiquarian for 1886, well describes one of these shelters as erected by the Apache-Mojaves. He says: "They live in circular brush huts (*u-wah'*) about five feet high, and from six to eight

* Shufeldt, R. W. The Evolution of House-building among the Navajo Indians. Vol. xv, pp. 279–282, Plates XLI–XLIII. Washington, 1892.

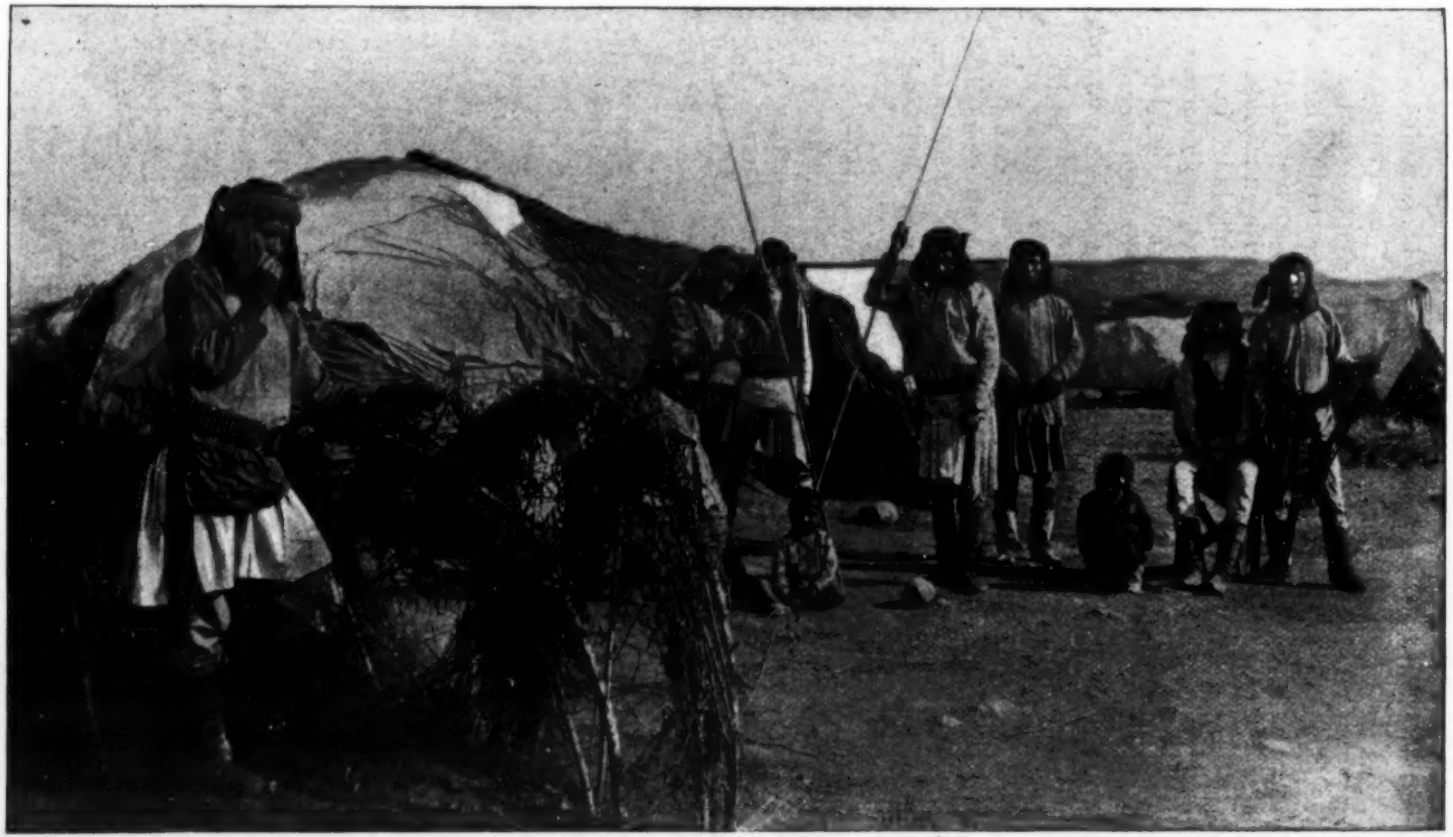

FIG. 1.—APACHE CAMP IN ARIZONA.

feet in diameter. To make one, a hollow space is excavated with sharp sticks and their hands, and the earth is banked up around the circumference until they have a bowl-shaped depression about a foot and a half deep. Around the edge of this, bushes or branches of trees are stuck, bent over and fastened together to form a round top. In winter it is thatched with grass, *tule*, or soap-weed, so that it will shed rain. An opening is left on one side, which serves as an outlet for smoke as well as a doorway. The fire is made just inside the opening. For a bed they break up the ground, let it dry, pick out the stones, and then spread down dry grass. Seeds, meat, buckskins, extra clothing, etc., are hung outside on upright poles. Formerly only a few huts were usually found together, and they were occupied by members of one family, as these people had to scatter over the country in small parties and move frequently in order to obtain a sufficient supply of food; but in seasons of plenty, villages of about one hundred souls would be formed, when the huts of each family were always built in a group by themselves."

As primitive as these dwellings now are, they were found to be somewhat more so by Lieutenant Whipple in 1853, and he reports that "an Apache wigwam is as rude, it is believed, as any race of human beings have been known to construct for abodes. These huts are usually isolated in some mountain gorge, near a rivulet or spring, and are composed of broken branches of trees. They are covered with weeds, grass, or earth, such as may be obtained most readily. A large flat or concave stone, upon which they grind corn or grass seed to flour, is the only utensil or article of furniture that they do not remove in their wanderings. Visits to the houses of Mexicans or their more enterprising Indian neighbors excite no desire to improve their condition by the erection of more comfortable habitations. Tents they do not use, even when robbed from Mexicans or some poor party of emigrants surprised and murdered. The Tontos, Yampais, and most of the Apache Indians within New Mexico and California are equally barbarous and rude in the construction of their habitations."

Those curious people, the Havesu-pai Indians, living in a great, deep cañon in Arizona, also build lodges of rushes and limbs, but they are rather more substantial than those I have described for the Navajos and Apaches. This is due to the fact that they use rough timber uprights, and a few stout pieces for rafters. Their houses are also more commodious, although they rarely contain more than the one large living-room.*

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* Shufeldt, R. W. Some Observations on the Havesu-pai Indians. Proceedings of the United States National Museum. Vol. xiv, pp. 387–390. Plates XXV and XXVI of this paper show the plans of the houses constructed by these Indians. Washington, 1891.

In my opinion, the next step taken in advance is by the Mojaves of Arizona, and those Indians build for themselves homes which are more or less permanent dwellings. One of these is shown in Fig. 2, and its architecture is certainly very remarkable. The upright portion of the frame is composed of very heavy timbers, each piece being completely stripped of its bark and firmly implanted in the ground. The rafters and the frame and ridge-piece for them to rest upon are also of timber much stouter than is at all necessary to support the roof. This

FIG. 2.—STYLE OF HOUSE BUILT BY THE MOJAVE INDIANS IN ARIZONA.

latter is composed of long prairie grass overlaid with a thick coat of mud-plaster. It is quite impervious to the rain, and the eaves at one side are not more than a foot and a half above the ground. Indeed, the peak or ridge of this house is hardly as high as an ordinary man's head. All the sides and the front are left open, but the back is usually built up with timber and filled in with mud-plaster, or sometimes these Indians build this kind of an abode into an embankment at its rear. Internally it is not partitioned off into rooms at all, and the right-hand side of the dwelling constitutes a sort of a porch or wing, wherein the roof is hori-

zontal, being much thicker than it is over the gabled portion. The floor is kept hard and clean inside, and most of the domestic arrangements are carried on in the open air. It will be observed that they have a lot of corn drying in a heap up on the roof, and their pottery utensils are in front outside.

Formerly it would appear that these Mojaves built a somewhat better home for themselves than this, and Lieutenant Whipple has said,* in reference to the figure of one he published in his report, that "the large cottonwood posts, and the substantial roof of the wide shed in front, are characteristic of the architecture of this people. This particular house appears to run into a sand-bank, and is peculiar. Others are formed in the valley, with all their walls supported by posts; and the longitudinal beams have their interstices filled up with straw or mud-mortar." . . . . The interior of a house consists of a single room with thatched roof, sandy floor, and walls so closely cemented by mud as to be nearly air-tight. It has no window, and receives no light except by the door which leads to the shed, and by a small hole at the top which gives egress to the smoke of fires. Structures similar to this are common throughout the lower portion of the Colorado Valley, and may be found also among the Coco-Maricopas and Pimas of the Rio Gila. With the latter, however, the circular hut, described by Mr. Bartlett, is much in vogue. In such gloomy abodes the Indians seek shelter from cold. Arranged around the walls are large earthen jars, in which they preserve their main supply of fruit and vegetables." Mojaves wear scarcely any clothing, especially the men, as may be seen from the individuals shown in my figure.

The more nomadic tribes of Indians, such as the Sioux of the North and others, when they come to build anything better than a *tepee*, erect a regular wigwam, a large, commodious structure of a conical form, supported by the cut trunks of saplings, and covered with ornamented or non-ornamented tanned buffalo-hides. Frequently I have been in one of those wigwams, and at almost any time of the year they are very comfortable, though rather warm in summer. All the buffaloes now being practically exterminated, those tribes which formerly built hide wigwams will now have to resort to the construction of other kinds of homes. Probably they will do as the Navajos have done, and come to erect houses more or less like the primitive one-room buildings of the early squatters. Navajos, however, place the timbers side by side in the vertical position, filling the interstices with mud-plaster, whereas, as we know, in the ordinary log-cabin they are laid one on top of another in the horizontal method, with

* Pacific Railroad Reports, vol. iii, p. 23, (1853–'54).

their ends molded upon each other by the aid of an axe, or an adz. The Choctaws have long built such houses, and the more intelligent tribes of the Indians on our frontier will undoubtedly follow their example, as they become completely surrounded by our advancing line of civilization.

From this point, did the scope of my article admit of it, I should like to show how, from such houses as have thus far been described, we pass through easy transitional stages to the higher types of architecture, or the communal homes of the Indians of the pueblos of New Mexico and Arizona. Such a treatise, however, would form quite a volume, and far exceed my limits.

In those transitional stages to which I refer, it can be shown that a great many interesting forms of homes are built, or

FIG. 3.—WOLPAI, A MOQUI INDIAN VILLAGE.

used to be built, by the Indians. These present every imaginable form: in some the thatching is very well done, and very ingenious; in some the door is at the side, while in others it is on the roof; they contain single rooms, as well as rooms *en suite*; and finally they gradually pass from the use of brush, poles, hides, and mud-plaster to the employment of *adobe*-plaster, rubble-stone, and *adobes*. Mr. Lewis H. Morgan has said that "a comparison will show that they belong to a common indigenous system of architecture. There is a common principle running through all this architecture, from the hut of the savage to the commodious joint-tenement house of the village Indians of Mexico and Central America, which will contribute

to its elucidation."* And in the same work this distinguished author adds that the same common principle runs through all this Indian architecture, "from the 'long house' of the Iroquois to the 'pueblo houses' of New Mexico, and to the so-called 'palace' at Palenque and the 'house of the nuns' at Uxmal. It is the principle of adaptation to *communism in living*, restricted in the first instance to household groups, and extended finally to all the inhabitants of a village or encampment by the *law of hospitality*. Hunger and destitution were not known at one end of an Indian village while abundance prevailed at the other. Joint-tenement houses, each occupied by one large household, as among the Iroquois, or by several household groups, as in Yucatan, were the natural and inevitable result of their usages and customs. Communism in living, and the law of hospitality, it seems probable, accompanied all the phases of Indian life in savagery and barbarism."

Several years ago the present writer visited the pueblo of Zuñi in New Mexico, and I have seen some of the others, as well as the ruins of a number of the ancient ones. Both New Mexico and Arizona to-day offer a rich field for the investigations of the thoughtful, scientific anthropologist, for in many localities in each Territory he will not only find, in all stages of preservation, the old ruins of the almost extinct "cliff-dwellers," the remains of former pueblos; but he will likewise have the opportunity of comparing the previous states of those communal villages with several of them still in existence. There are about twenty pueblos in New Mexico that are still inhabited, and in Arizona we find seven more that constitute the Moqui group. Many of these have been studied by members of several of the Government exploring parties, and by other individuals, but there still remains a vast store of knowledge in regard to them that no one has as yet drawn upon. This to be done at all must now be done quickly, for our own civilization presses closer upon them each year that goes by, and will very soon work its invariable changes.

Some of these pueblos are built out upon the level, open plain, several miles from any high or mountainous land, and are usually near some river-course, as in the case of Zuñi or Santo Domingo; or they may cap the extremity of some bold *mesa*, five or six hundred feet above the surrounding prairie, as is the case with the Moquian pueblo, Wolpai (Fig. 3).

Substantially their plan of structure is the same, though it may differ considerably in detail, and this likewise applies to the

* Houses and House-life of the American Aborigines. Department of the Interior, United States Geological and Geographical Survey of the Rocky Mountain Region. Washington, 1881, pp. 104, 105.

mode of life of their inhabitants. Massed together and built of *adobes* of rock laid in mud-mortar, and reared in tiers or terraces of from two to three or more stories high, they admirably fulfill

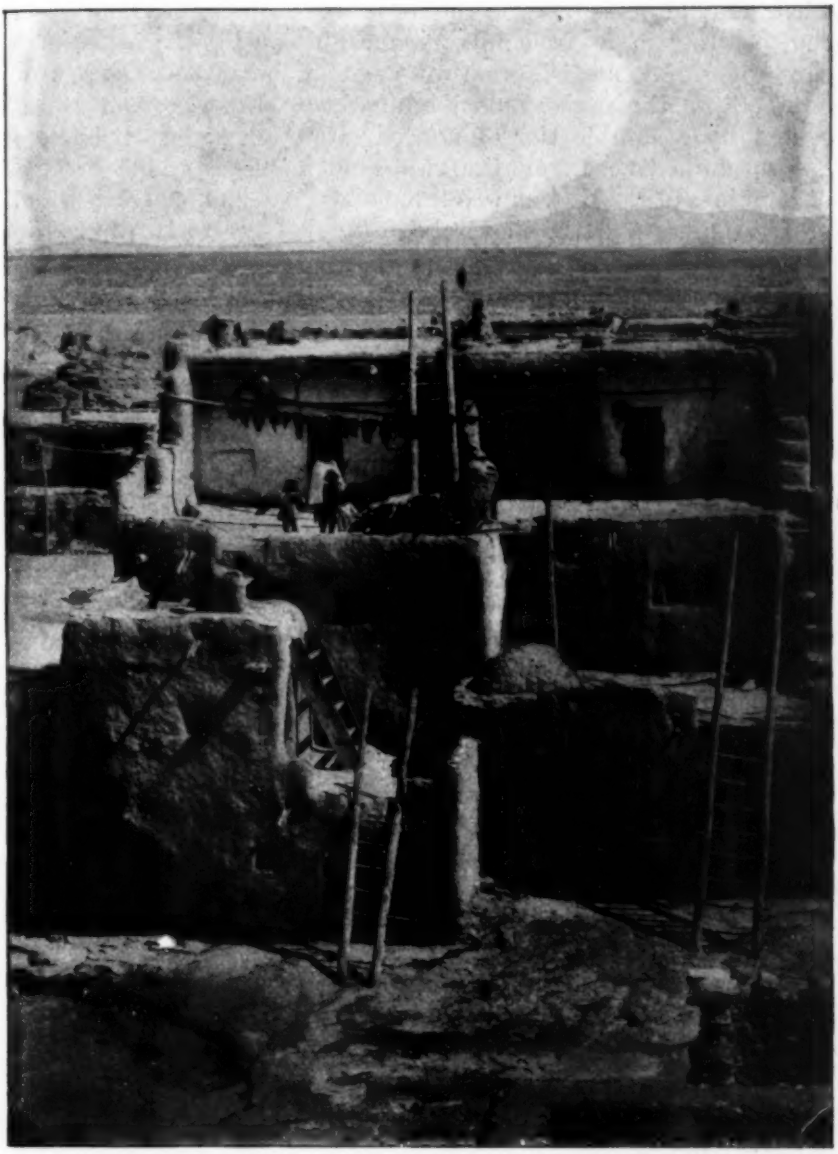

FIG. 4.—TERRACE HOUSES IN THE PUEBLO OF ACOMA, NEW MEXICO.

the triple purpose of a durable architecture, a communistic plan of living, and as a fortress in the event of an attack from outside marauders.

Many of the pueblos, now in ruins, were at the time of Coronado's expedition to New Mexico, in 1541–1542, at the height of their vitality, and a study of a number of these go to show that in their arrangement they were built upon some definite plan. Their ground plans point to the fact that they were laid out upon the quadrate of a circle in some instances, while in others the three sides of a parallelogram were chosen, or roughly the arc of a subellipse, the major axis joining the extremities, and represented by a double tier of houses. In other cases the entire ellipse can be traced from the ruins, but houses were not erected on the lines of its axes, as was the plan in Pueblo Peñasca Blanca. Most of these and the more elaborate ones are found upon the Rio San Juan and its tributaries; others are seen upon the Rio Animas, in the cañon of the Rio de Chelly, in the Ute Mountains, and elsewhere.

Of the pueblos yet inhabited the best examples are seen in the Moqui group, in Zuñi, Acoma, Santo Domingo, and Laguna. Apart from the demoralizing influences of the Roman Catholics upon some of them, and the changes brought about by our civilization, these pueblos may be taken as fair examples, though by no means of the highest type, of what existed in the country at the time of the discovery. All these tribes have been termed the sedentary Indians, and they enjoy a sort of crude civilization of their own: engage in agriculture, make pottery, weave blankets and many garments of wool, and have many other simple arts and industries. They are the descendants of the inhabitants of the ancient pueblos discovered by Coronado, and in many instances are occupying, in the present villages, houses which certainly are as old as his time. Their government, religious rites and ceremonies, their dances and customs, habits and dress, and domestic life are all full of the greatest interest, but can not properly be treated in the present contribution.

My view in Fig. 2 of some of the houses in the pueblos of Acoma, New Mexico, shows very well their structure and arrangement. It will be seen that they are built in three tiers or terraces, one on top of another. The material used is *adobe* cobblestone flakes gathered from the country about, and laid in *adobe* or mud-mortar. The roofs are made of cedar rafters, hewn and brought in by the men, who also fetch in most of the stone material. Plastering, however, is done by the women, who puddle the mud and lay it on with their hands. While thus engaged, its consistency is regulated by their squirting water upon it, which they take into their mouths for the purpose. It will be observed that the lower stories of houses have few or no entrances, and this is undoubtedly for the purpose of defense. Their roofs form the terrace to the second tier, which is reached by the means of ladders.

Sometimes, too, the partitions or vertical walls between the houses are extended upward, and externally are formed into steps, each step being made by a slab of stone as seen in the figure. Ladders are also used to reach the other terraces, as well as the roof that tops the whole of this human bee-hive. In Zuñi I found doors opening from the street directly into the rooms of the ground-floor, and there were many hatchways in the roofs, the rooms below being reached by the means of ladders, such as the long ones shown in my picture of Acoma. Chimneys are built up with stone and mortar, and frequently are topped off by a large clay *olla* set in the latter, after having its bottom knocked out so as to give egress to the smoke from the stone fireplace found in so many of the rooms.

Small windows with four panes each admit a meager light to the interior of these dwellings. These panes are most often composed of mica obtained in the mountains, but of recent years they have not infrequently obtained glass from the whites suitable for the purpose, and they always prize that material very highly. Rain which accumulates on the several roofs during the continuance of storms, finds its escape at guttered apertures supplied with small troughs, shown in the engraving. Often a dome-shaped oven is built out on the roof in one of the angles, and in this they bake their bread. One of these is also shown in the picture, and at Las Nutrias Pueblo, in New Mexico, I saw that they built these ovens out on the ground, and were baking *tortillas* in them at the time of my visit.

One of these pueblan houses rarely has less than three rooms, and may contain as many as eight or nine. Most of those that I have been in—and I have been in a good many of them—are kept scrupulously clean and neat. Their repair devolves entirely upon the women, who consider it their especial prerogative. The floors are evenly laid in moistened clay, and when that material dries, an excellent surface is the result, hard and smooth. They make a kind of whitewash of gypsum, with which the smoothly plastered walls are kept constantly white.

The ceiling overhead is composed of a generous supply of stout rafters of cedar that run horizontally across from wall to wall, and at Zuñi, the Indians had filled in the interspaces with osier brush, covering the outside or roof with a heavy layer of *adobe*-plaster. Often an entire family is confined to one large room, or, if better circumstanced, they may control two or even more.

Conspicuous among its finishings in the living-room are the arrangements to do the family cooking. Sometimes the fireplace, built of the usual masonry, is fitted into one of the angles of the room; sometimes it juts out at the middle of the long side of the apartment; in either situation the chimney, smaller in its dimen-

FIG. 5.—SCENE IN A COURT-YARD OF LAGUNA PUEBLO, NEW MEXICO. (The corn-dance in progress.)

sions, rests by its base on its horizontal upper plane, leaving always a mantel-shelf all round. In front of either one of these we find the contrivance upon which they bake their tissue-bread or *waiavi*, and projecting out above it the hood which conducts the smoke into the chimney. This contrivance is nothing more than an oblong stone slab, as smooth as polished glass upon its upper surface, and raised on four legs at its angles about a foot and a half above the cemented floor. Beneath this glowing embers are raked in sufficient quantity to keep the slab hot, and it thus answers its purpose admirably.

"In Zuñi, as elsewhere, riches and official position confer importance upon their possessors. The wealthy class live in the lower houses, those of moderate means next above, while the poorer families have to be content with the uppermost stories. Naturally no one will climb into the garret who has the means of securing more convenient apartments, under the huge system of "French flats," which is the way of living in Zuñi. Still, there is little or no social distinction in the rude civilization, the whole population of the town living almost as one family. The alcade or lieutenant-governor furnishes an exception to the general rule, as his official duties require him to occupy the highest house of all, from the top of which he announces each morning to the people the orders of the governor, and makes such other proclamation as may be required of him."*

There is one other prominent object in the living-room of a Zuñian home which we can not afford to overlook in the present account. I refer to the troughs in which they grind their corn, and Mrs. Stevenson, whom I have just quoted, gives an excellent account of one of these. She remarks that "the pueblo mills are among the most interesting things about the town. These mills, which are fastened to the floor a few feet from the wall, are rectangular in shape, and divided into a number of compartments, each about twenty inches wide and deep, the whole series ranging from five to ten feet in length, according to the number of divisions. The walls are made of sandstone. In each compartment a flat grinding-stone is firmly set, inclining at an angle of forty-five degrees. These slabs are of different degrees of smoothness, graduated successively from coarse to fine. The squaws, who alone work at the mills, kneel before them and bend over them as a laundress does over the wash-tub, holding in their hands long stones of volcanic lava, which they rub up and down the slanting slabs, stopping at intervals to place the grain between the stones. As the grinding proceeds the grist is passed from one compartment to the next until, in passing through the series, it becomes

* Mrs. James Stevenson, in Lewis H. Morgan's report, cited above.

of the desired fineness. This tedious and laborious method has been practiced without improvement from time immemorial, and in some of the arts the Zuñians have actually retrograded." *

The above is a faithful description of one of the pueblan mills; I observed a great many of them at Zuñi, and elsewhere have said that I "saw standing behind one of the stone slabs where they grind their corn, a pretty Zuñi girl, not a day over a year old, and as naked as the hour she was born, with the stone grinder in her hands, playfully showing her mother, who watched her with no little pride in her face, how to grind the corn. The picture was a charming one, and if the expressions of all could have been caught at the proper moment, what a study it would have made!" †

The tiers of houses at Zuñi, in common with a number of the other New Mexican and Arizonian pueblos, are clustered about two open squares or public plazas of no very great size, a portion of one of them being used as a graveyard in front of the abandoned mission church in Zuñi. In Fig. 5 of the present article I give the court at Laguna Pueblo of New Mexico, which is there kept clean and neat. This picture well shows the arrangement and relation to each other of these conglomerate homes. In this engraving the annual "corn-dance" of the Lagunas is being performed—a very interesting ceremony.

Thus in the present account I have passed briefly in review the study of the homes which the American Indians build for themselves in these days. The subject could easily be enlarged upon, and, indeed, treated in detail, would fill three or four ample volumes. My labor, however, will have been well repaid should it be the means of inciting the student in anthropology, with a knowledge of the present literature of the subject, to broaden the field by published accounts of his or her own observations. Much yet remains to be carefully studied and compared, much that is yet obscure or totally unknown to science. It must be done in the near future, for already many of the facts are rapidly fading upon the unturned pages of aboriginal American history.

THE forests of Chaga, the temperate zone of Mount Kilimandjaro, Africa, as described by Dr. W. L. Abbott, have a most curious appearance. The trees, although often of very thick trunks, are not tall but somewhat stunted. The trunks and larger branches are completely covered with orchids, lichens, ferns, and moss. From every limb and twig hang long festoons of gray moss, while the ground is thickly carpeted with ferns of a species resembling "love in a tangle." Some of the huge tree-trunks are perfect botanical gardens, from the number and variety of the plants growing upon them.

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* Lewis H. Morgan's report, p. 140.

† Shufeldt, R. W. Zuñi as it is. Forest and Stream, New York and London, July 2, 1885, pp. 446–448.

RECENT SCIENCE.

By P. KROPOTKIN.

I.

THE world of chemical phenomena is so immensely wide, and the phenomena themselves are so complicated, that the founders of modern chemistry were compelled to limit the area of their investigations, and sharply to separate their own domain from those of the two sister-sciences, physics and mechanics, leaving it to the future to find out the bonds which might unite all three branches into one harmonious whole. They and their followers elaborated their own methods of investigation; they discovered their own chemical laws and worked out their own hypotheses and theories; and, with the aid of these methods, laws, and hypotheses, they created a science which not only interprets, discovers, and predicts the phenomena it deals with, but already has brought us within a measurable distance of a general theory of the structure of matter altogether.

In proportion as chemical research went deeper into the study of the wonderful movements and interactions of molecules and atoms, the intimate connection which exists between chemistry, physics, and mechanics became more and more apparent. The physical and the chemical properties of matter proved to be so closely interdependent that they could be explained no longer with the aid of chemical theories alone; the very fundamental laws of chemistry appeared to be but so many expressions of physical facts; and chemistry stands now in such a position that no further advance in its theoretical part is possible, unless it enters the border-land which separates it from physics, recognizes the unity of chemical and physical forces, and, availing itself of the progress recently made in molecular mechanics, boldly attacks the great problem of a physical—that is, a mechanical—interpretation of chemical facts. This is the work which now engrosses the attention of most chemists.

The points of contact between physics and chemistry are very numerous, and the work is being carried on in several directions at once. The discovery by Mendeléeff of the so-called "periodical law of elements" has called into life numerous researches, some of which accumulate correct numerical data to express the dependence between the physical properties of various bodies and their chemical constitution; while others endeavor to interpret this very periodicity in the properties of the elements under the assumption of their compound nature. On the other side, the recent development of the mechanical theory of heat, and the

interest awakened of late in electricity, have given rise to numerous researches aiming at a representation of chemical reactions as mere transformations of heat-energy or electricity. And, finally, most skillful investigations are being made, and most suggestive hypotheses advanced as regards the possible distribution of atoms within the molecules, under the supposition of their remaining in a state of equilibrium; and thus the way is prepared for a higher conception of the atoms—not motionless and mutually equilibrated, but involved, like the planets of our solar system, in complicated movements within the molecules. Works of importance have appeared of late in each of these directions. But no other domain has lately been explored with such a feverish activity as the vast domain of *solutions;* and to these researches we must now turn our attention.

In former times it was supposed that if some table-salt or sugar (or any other solid, liquid, or gas) is dissolved in water or in any other liquid, the particles of the dissolved body will simply spread, or glide, between the particles of the solvent, and simply be mixed together—just as if we had made a mixture of two different powders or two gases. But on a closer study a succession of most complicated and unexpected phenomena was revealed, even in so simple a fact as the solution of a pinch of salt in a tumbler of water. The solutions proved to be the arena upon which phenomena cease to be purely physical, and become chemical, and they were studied accordingly with the hope that they might give a physical cue to chemical reactions. Hundreds of researches are contributed every year to this subject;* and although there is yet no final result to record, we are bound nevertheless to examine the present state of investigations which so much interest and excite chemists.†

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* The committee appointed by the British Association for reporting on the bibliography of solutions had catalogued no less than 255 papers, which appeared in 1890, in a few periodicals only. The total was at that time 930 papers.

† We know no general review of this extremely complicated question which we might recommend to the general reader. The address delivered by Prof. Orme Masson before the Australasian Association for the Advancement of Science, in January, 1891; Prof. S. U. Pickering's Report to the British Association, in 1890, on the hydrate theory of solution, followed by a most interesting discussion between Profs. Gladstone, Arrhenius, Armstrong, Fitzgerald, Van 't Hoff, Lodge, Ostwald, and Ramsay, and the elaborate report, by W. N. Shaw, on electrolysis (British Association Reports, 1890, Leeds), are excellent sources of general information. Ostwald's work, Solutions (English translation in 1891), as well as his Lehrbuch der allgemeinen Chemie (Leipsic, 1885; new edition of first volume in 1892), and the review, Zeitschrift für physikalische Chemie, which he publishes since 1887, unhappily take but little notice of the chemical aspects of the question. Mendeléeff's foot-notes in his most remarkable Principles of Chemistry (London, 1891) are perhaps, on the whole, the best means for gaining a general and impartial insight into the whole question. Though himself one of the earliest promoters of the hydrate or chemical theory of solutions, he

Few scientific hypotheses have proved so productive in the development of science altogether as the so-called "kinetic theory of gases." A gas, according to this hypothesis, is an aggregate of molecules which move very rapidly in all directions and endeavor to disperse in space—the rapidity of their movements being increased by every increase of the temperature of the gas. In their endeavors to escape in all directions the molecules of the gases continually bombard the walls of the vessels which contain them. They break them if they are weak enough, or else they exercise upon them a pressure which is nothing but the sum of all energies of the molecules which strike a unit of surface in a unit of time. In our steam-engines the molecules (or rather particles) of steam bombard the walls of the cylinder; they push the piston by their aggregate energies, and, setting it in motion, make it move the huge masses it has to move. This is, of course, but a hypothesis; but since it so perfectly explains the pressure, the elasticity, the diffusion, and the internal friction of gases, and permits us to predict the consequences of the invisible bombardment; and since its consequences, mathematically deduced by Maxwell, Clausius, Boltzmann, and many others, fully agree with the reality of facts—it can be considered no more as a mere guess: it is a theory.

Now, the Dutch chemist Van 't Hoff proved in 1886 that the same theory holds good for weak solutions as well. If some sugar, or some sulphuric acid, or any other liquid or solid, be dissolved in some liquid, the bonds which keep together the particles of sugar or of the acid are torn asunder by the solvent. The particles spread among those of the solvent, and they take up the same movements which they would perform if the sugar or the acid were brought into a gaseous state in a free space. They bombard the walls of the vessel, and exercise upon them a certain pressure which will be increased if the bombardment is rendered more violent by either raising the temperature of the solution, or increasing the number of bombarding particles by a limited increase of its strength. Though there is not the slightest reason for supposing that the dissolved solid or liquid may be in a gaseous state within the solvent, the very fact of scattering its particles over a broad space is sufficient to free them from their mutual bonds; they behave exactly as if the sugar or the acid were brought into a gaseous state by evaporation and filled the space occupied by the solution. They obey all the physico-chemical laws (the laws of Boyle, Marriotte, Gay-Lussac, and Avogadro) which hold good for gases.

The kinetic theory of *gases* was thus extended to *liquids*, and

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fully recognizes the importance of the physical theories, and sums them up with his usual clearness.

this first step was soon followed by another, even more important step, when Van der Waals—also a Dutch chemist—still more effectively bridged over the gap between the gaseous and liquid condition of matter. He studied that state of a gas when, under an increasing pressure and a decreasing temperature, it becomes a liquid; and he found a mathematical expression (an equation) which very approximately represents the mutual dependence between the volume occupied by the gas under a given pressure, its temperature, the volume occupied by its particles, and their mutual pressure. He thus expressed in a more comprehensive way how, in proportion as the lengths of the paths of its particles decrease, a gas becomes a liquid.*

The long-since suspected continuity between the gaseous and liquid states of matter was thus demonstrated once more, and rendered easy to investigate; and the importance of these conclusions was still more enhanced by Clausius, when he demonstrated that a slight alteration of Van der Waals's equation makes it also represent the absorption or dissipation of heat-energy which always takes place when a body passes from the liquid to the gaseous state, or *vice versa*.

And, finally, another step in the same direction was made by the French physicist, Raoult. We all know that if some table-salt, or saltpeter, or some other salt, be added to water, the water may be cooled below zero without freezing. Its freezing temperature is lowered. Now, Raoult studied the lowering of this temperature caused in water and other liquids by the addition of various amounts of various salts, and he came to a most remarkable result. It appeared that, whatever the nature of the dissolved salt may be, the freezing temperature of a solution will always be lowered by the same amount (nearly six tenths of a degree) if we add one molecule of the dissolved body to each hundred molecules of the solvent.† Thus, again, a purely physical fact, such as freezing, proves to be dependent upon a purely chemical fact—the molecular weights of the solvent and the dissolved body; and this physical law is so general that it has become a very accurate means for determining such chemical data as molecular weights. Chemistry and physics appear again so closely interwoven that there is really no means of separating them.

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* See the interesting discussions which took place upon this subject in the Physical Society, in October and November last.

† Thus, if table-salt be used, the weight of its molecule (compared with a molecule of hydrogen) is 58½; while the weight of a molecule of water (also compared with hydrogen) is 18. So that, if we add 58½ ounces of table-salt to each 1,800 ounces of water, we shall lower its freezing temperature by 0·62° of the centigrade scale. The same result will be obtained if we take 74½ ounces of potassium chloride, or 101 ounces of saltpeter, to the same amount of water.

It is not possible to describe in a few words the impetus given by the discovery of these connections to physico-chemical research altogether. A school, headed by Ostwald, of most enthusiastic supporters of what has been termed (not quite properly) the physical theory of solutions, has grown up; and this school, while bringing out a mass of important researches and widening the field of chemical investigations, has naturally come to consider itself as being on the right track for elaborating a complete theory of the subject. Unhappily, this is not the case, because the chemical reactions which undoubtedly take place in solutions are not taken into account in the just-mentioned physical laws. In reality, so long as but small amounts of solids, or liquids, or gases are dissolved in a liquid, and so long as only such bodies are brought into contact as have no strong chemical affinity for each other, the above theories are quite correct. But as soon as the solution is rendered stronger, or the solvent and the dissolved body are endowed with a mutual chemical affinity, chemical reactions set in. Part of the molecules of the dissolved body dissociate, and the atoms of which they were composed, on being set free, combine with the atoms of the solvent. Chemical forces, much more energetic than the physical forces, enter into play, and most complicated chemical reactions—the intensity of which may be judged of from the changes of temperature—begin. To deny them is simply impossible, although this has been done in the excitement of polemics. The chemical reactions which take place within the solutions, and especially the formation of definite though unstable compounds of salts, acids, and bases with water, have been rendered evident by so many careful investigations of experienced chemists,* that the secondary importance given to them by most adherents of the physical theory would be simply incomprehensible were it not for the hope which they cherish of ultimately explaining all chemical processes by the above-mentioned molecular movements. At any rate, in order to account for the effects of the chemical reactions, the followers of the physical theory were compelled to seek support in an additional agency—electricity. Starting from the familiar fact of solutions being decomposed by an electrical current, they admitted that in every solution part of its molecules dissociate, breaking up into their component parts, which are charged with either positive or negative electricity (the name of "ions" is usually given to those component parts). By means of this admission, they attempted to explain the discrepancies between observation and the conclusions drawn from the above-mentioned laws,

* We need only mention the names of Armstrong, Etard, Pickering, Mendeléeff, and so on.

especially in the case of water solutions of salts, acids, and bases, and the stronger solutions altogether. It must be recognized that many important relations between electrical conductivity and chemical action have been brought out in this way by Arrhenius* and his followers, and many discrepancies between the laws of Van 't Hoff and Raoult and the observed facts have been explained. But it is also evident that, once a partial dissociation of molecules is admitted, the whole takes a chemical aspect, and reference to such an unknown cause as electricity does not simplify the matter. All kinds of chemical reactions take place in solutions. Some molecules of the dissolved body simply exchange their atoms in succession, while maintaining the same grouping of atoms, and consequently the same chemical composition. In other molecules the grouping only of the same atoms is changed, and we have reactions of replacement, or isomerism. But, at the same time, new and more or less stable combinations between the atoms of both solvent and dissolved body take place in various proportions; double decompositions most probably occur as well; while the physical phenomena of sliding of undecomposed particles continue at the same time—the *physical* movements of the particles being impressed by, and acting upon, the *chemical* movements of the atoms within the molecules.

It must be confessed that neither theory has as yet succeeded in following this multitude of movements and of catching the moment when the movements of particles are transformed into atomic movements and redistribution; and though we may name several equally important works which have been published on this subject during the last twelve months, we can mention none which have thrown new light on the subject.† Let us only add that the subject itself has been immensely widened of late by the wonderful researches of Heycock and Neville on the lowering of the temperature of solidification of metals, by the addition of other metals, and of Roberts-Austen upon alloys—that is, metals dissolved in metals—which behave very much like all aqueous solutions. However, a new departure in this branch has been made, quite recently, by Messrs. Harold Picton and S. E. Linder. They studied the structure of solutions of sulphide salts which offer the advantage of giving a whole series of gradations between real solutions (that is, liquids which seem to consist of liquid particles only) and such as contain extremely small particles of solid matter in suspension. By submitting the series to various tests, it

* Svenska Vetenskaps Academiens Handlingar, 1863.

† Besides the leading chemical periodicals, an excellent analysis, by W. Nernst, of all the chief work done during the year 1891, and its bearing upon the theory of solutions, will be found in a chemical year-book which was started this year by Richard Meyer, the Jahrbuch der Chemie. Frankfort, 1892.

was ascertained that all these solutions, even those reputed as homogeneous, contain infinitely small solid particles, the presence of which is revealed, on Tyndall's method, by a beam of light. In some of them the particles—all of the same size and performing rapid oscillatory movements—are even seen under the microscope, when magnified a thousand times; while in antimonium sulphide the very formation of coarser agglomerations out of invisible particles can be followed under the microscope. In short, the authors came to the conclusion that there is no sharp limit between a state under which the mutual attractions between the particles of the solvent and the suspended particles of the dissolved body are very feeble, and a state when, these aggregations becoming of a smaller size, the forces which keep them in the solution become of a decidedly chemical nature. A new and promising method is thus given.

If we take into account the rapid accumulation of data relative to the subject of solutions and the various theories already germinating, we may hope that the day is not far off when a complete theory of these phenomena will be possible. Let us only remark that all the work hitherto done confirms more and more the idea which becomes more and more popular among chemists, and which Mendeléeff has so well expressed in a lecture delivered before the Royal Institution in May, 1889;* namely, that the molecules of all bodies, simple or compound, borrow their individualities from the characters of the movements which the atoms perform within the molecules. Each molecule may be considered as a system, like the systems of Saturn or Jupiter with their satellites—each separate type of such systems giving a separate type of molecules, and the chemical properties of the molecules being determined by the character of the system and its movements. It may already be foreseen that further progress in the great investigation into the mechanical basis of chemical energy will be made in this direction.

II.

One of the chief objections to the theory of evolution which was especially laid stress upon some thirty years ago, was the impossibility of producing at that time a series of "intermediate links" to connect the now existing animals and plants with their presumed ancestors from former geological epochs. To meet the objection, Darwin had to devote a special chapter in his great work to the imperfection of the geological record, and to insist both upon its fragmentary character and our imperfect knowledge of what it contains. The recent progress of both geology

* An attempt to apply to Chemistry one of the Principles of Newton's Natural Ph losophy, in the Principles of Chemistry, vol. ii, Appendix I.

and paleontology renders such explanations almost superfluous. Geology, aided by the deep-sea explorations, has come to a better comprehension of the mechanism of sediments, and it knows what it may expect to find in the rocky archives of the earth, and what it may not; and, on the other side, the discovery of the missing links between past and present has been going on of late with such a rapidity as has outstripped the most sanguine expectations. Our museums already contain whole series of fossil organisms which almost step by step illustrate the slow evolution of large divisions of both animals and plants; our present mammals already have been connected by intermediary forms with many of their Tertiary ancestors; and the paleontologist can already trace the pedigree of birds, and even mammals, as far back as the lizards of the Secondary period—not merely deducing it from embryological data, but by showing the real beings which once breathed and moved about upon earth.

At the same time one point of great moment for the theory of evolution, and only alluded to by Darwin, has been brought into prominence. The part played by migrations in the appearance of new species has been rendered quite obvious. Thus we know perfectly well that the ancestors of our horse migrated over both Americas, Asia, Europe, Africa, and probably back to Asia, and that each step in those migrations was marked by the apparition of some new characters which are now distinctive of the horse. The same remark applies to the mastodons and their descendants, the elephants; to the common ancestors of the camel and the llama, and to the Ungulata altogether. It may be taken now as a general rule that the evolution of new species chiefly took place when the old ones were compelled to migrate to new abodes, and to stay there for a time in new conditions of climate and general surroundings. The intermediate forms have *not* been exterminated on the spot; and if we want to obtain the intermediate links between two allied species, the relics of which are found in two geological formations of a given country, we must ransack for fossils all the five continents upon which the intermediate links have been scattered. This is why the discovery of intermediate types has gone on so rapidly since North America, South Africa, South America, New Zealand, and partly Asia began to be thoroughly explored by experienced paleontologists.

Many of the "missing links" were discovered, as is known, in Darwin's lifetime. Thus, the first really bird-like, feathered lizard, the *Archæopterix*, was unearthed as early as 1862; and eight years later, Prof. O. C. Marsh already described, from the Upper Cretaceous beds of North America, two more lizard-birds, one of which (*Hesperornis*) must have resembled our present fish-eating divers, while the other (*Ichthyornis*), provided with power-

ful wings, had—apart from its teethed jaws—all the appearance of a bird of our own time.* And, finally, the discovery of a large ostrich-like bird (*Dasornis Londinensis*) in the Lower Eocene of the isle of Sheppey, and of another, also big and flightless bird (*Gastornis*), in the Eocene of Meudon, Rheims, and Croydon, established a further connection between the bird-like lizards of the Triassic times and real specialized birds.

These last discoveries brought the series very near to our own times, and they were the more valuable as the just-mentioned *Gastornis* proved to combine some of the characters of both flying birds and of those which, like the ostrich, the cassowary, and the emu, do not fly; while the Pliocene deposits of north India and the numberless remains of the so-called *moas* of New Zealand yielded specimens of still nearer ancestors of our flightless birds. The New Zealand deposits of bones became known more than fifty years ago, when Owen, on receiving (in 1839) a broken but characteristic moa bone, determined the general characters of the great ostrich-like *Dinornis*, which inhabited the island quite recently, but is found no more in a living state. But it is especially of late that the enormous accumulations of moa remains have been explored in detail. Cart-loads of those bones have already been shipped to Europe, and new accumulations continue to be found—always with the same astonishing numbers of individuals entombed on the same spot, and in the same excellent state of preservation. Such a deposit—one of the most remarkable of its kind—has been lately discovered by Prof. H. O. Forbes, near Oamaru, in the South Island of New Zealand. In a small hollow which did not exceed twelve yards in width, no less than eight hundred to nine hundred individuals were imbedded in solid peat, under a superficial layer of a few inches of soil. Many skeletons lay quite undisturbed, and in some instances the contents of the stomach, which consisted of triturated grass and small rounded and smooth quartz pebbles, were found lying in their natural position, under the sternum. The bones of a giant buzzard, a big extinct goose, the Cape Barron goose, the kiwi, and so on, were mixed together with bones and full skeletons of several species of *Dinornis*, big and small.† And again, as on previous occasions, the New Zealand scientists are at a loss to explain the accumulation of so many various birds on such a narrow space. However, the most interesting part of Prof. Forbes's dis-

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* R. Lydekker's Catalogue of Fossil Birds of the British Museum, London, 1892. For the general reader we can not but highly recommend a charming book of the same author, Phases of Animal Life, Past and Present, London, 1892, which is a real model of scientific and popular literature.

† Letter to Nature, March 3, 1892, vol. xlv, p. 416.

coveries is that he has finally succeeded in finding among this mass of bones one bone, at least, which bears unmistakable traces of having been connected with a humerus, the head of which must have been as substantial as in cassowaries. He thus considers it proved that the *Dinornithidæ*, like the kiwis, descended from birds which could fly.* The last missing link is thus discovered, and the chief points in the genealogy of birds are thus already settled, while many a gap which still remains will certainly be filled up when the rich materials recently excavated in both Americas have been carefully examined by anatomists.

The same may be also said in regard to mammals, if the recent discoveries in North and South America are taken into account. The earliest traces of mammals have been found, as is known, in the Triassic deposits of Germany, Basutoland, the Cape Colony, and North Carolina; and it is also known, through the previous remarkable works of Professors O. C. Marsh and H. F. Osborn, that the Jurassic deposits of Wyoming have yielded a rich fauna, among which we find the remote ancestors of various orders of the present mammalia.† But the most important finds, which throw a new light both on the earlier and the subsequent forms, have been made in that immense area of lacustrine beds which have been deposited in the region of the great salt lakes of Utah, Wyoming, and Colorado, from the end of the Cretaceous period down to the middle parts of the Tertiary epoch. There, and especially in the Eocene "Puerco" and "Wahsatch" beds, as well as in the Eocene "Uinta" formation, a rich fauna of mammals has been unearthed.‡ All those Eocene mammals had something in common in their leading features, and yet they offered a sufficient diversity for being considered as the probable ancestors of nearly all orders of placental mammals. To mention their feet only, they were adapted, in all of them, for walking upon the sole, and were provided with five toes; but it is easy to recognize in the structure of the feet of the different genuses such divergences as necessarily ought to evolve, under certain conditions—on the one side, the plantigrade foot of the bears, and, on the other side, the digitigrade foot of the Ungulata (horses, camels, elephants, and so on), who walk upon the points of their toes; and, again, among

* Nature, 1892, vol. xlv, p. 257.

† O. C. Marsh, in American Journal of Science, 1888 to 1891; H. F. Osborn, The Structure and Classification of Mesozoic Mammalia, in Journal of the Academy of Natural Science of Philadelphia, vol. ix; R. Lydekker, Catalogue of the Fossil Mammalia in the British Museum, London, 1891.

‡ Cope's Synopsis of the Vertebrate Fauna of the Puerco Series, and W. Scott and H. F. Osborn, The Mammalia of the Uinta Formation, in Transactions of the American Philosophical Society, new series, vol. xvi, Parts II and III, Philadelphia, 1889. Also R. Lydekker's paper in Nature, vol. xliii, p. 177; and Phases of Animal Life.

these latter it is possible to find indications for an evolution which must have ended in the appearance of two divisions—the odd-toed and the even-toed ungulates. Most laborious anatomical researches were required for properly interpreting these rich materials. But the result of the work is that we already know with a great approach to certitude the genealogical trees of most ungulates; we can go back to the ancestors of the ruminants, the cameloides, the chevrotains, the horses, and even to the common ancestors of the whole group of ungulates; while the genealogy of other large groups of mammalia has also been worked out to some extent.

The just-mentioned discoveries in North America were soon supplemented by still more remarkable finds in South America, which finds follow each other with such a rapidity that anatomists will have to make strenuous efforts in order to keep pace with the paleontological work. The formation which D'Orbigny described as "formation guaranienne" proved to consist of marine Cretaceous beds, covered by immense land deposits, which, like the Laramie beds of North America, are of an intermediate age between Cretaceous and Tertiary. These last beds offer an immense interest, owing to their mammalian fossils (of much more specified types than those of the Laramie), which are mixed together with relics of gigantic Dinosaurians, some of the latter attaining lengths of more than one hundred and thirty feet. As to the more recent deposits of the Argentine Republic and Patagonia—partly Eocene and partly Pliocene—they are so rich in mammals that more than two hundred species, some of them of the most extraordinary types, have already been described by Dr. F. Ameghino,* Burmeister, and Moreno; and every number of the Revista Argentina brings some new descriptions of new fossils both from the Argentine and Patagonia, which is now explored by Carl Ameghino. There are among them ungulates which, to use Mr. Lydekker's words, are "totally unlike any found in all the rest of the world put together," † and which combine the characters of both the odd-toed and the even-toed ungulates. Of them, the *Macrauchenia* seems to be a direct descendant of a type which must have been a common ancestor to both divisions. Another huge mammal, one of the *Toxodontes*, which must have equaled in size the hippopotamus, also occupied an intermediate position between the two groups; while in the earlier Tertiaries there are types which, so far as can be judged from

* His chief works are: Los mamíferos fósiles de la America del Sud, Buenos Ayres, 1880; Contribución al conocimiento de los mamíferos fósiles de la República Argentina, 2 parts, forming vol. vi of Actas de la Academia de Ciencias de Córdoba, Buenos Ayres, 1889; and several papers in Revista Argentina de Historia Natural, Buenos Ayres, 1891.

† Nature, vol. xlv, p. 608.

preliminary descriptions, must have stood near the source from which both ungulates and rodents have taken their origin.

Very many interesting Edentata and rodents have been met with in the same beds, but it is the marsupial group which surpasses all others in interest. One carnivorous animal of this group (*Prothylacinus*) is almost identical with the now existing pouched wolf (*Thylacine*) of Tasmania; while another fossil genus (*Protoproviverra*) is quite akin to the most characteristic carnivorous marsupial, the Tasmanian Devil. Although F. Ameghino's descriptions are not yet complete, the best authorities on this subject in this country and Germany do not hesitate to recognize a purely Australian type in these South American forms, which, on the other side, can safely be connected with the group of primitive carnivors (*Hyænodon, Pterodon*, etc.) which appeared at a later epoch in Europe. Moreover, the same beds contain fossil remains of primates (*Homunculus, Anthropops, Homocentrus, Eudiastatus*) which seem to represent ancestors of all the subsequent apes, but stand also in connection with the lemurs, and also with the ungulates, or, rather, with their *Toxodon* ancestors. They seem to represent the most ancient primates known, and indicate that the first representatives of the whole group must be sought for as far back as the end of the Secondary period. Finally, we must mention the discovery of remains of man which are considered by F. Ameghino as belonging to the Pliocene and Miocene ages.*

The "missing links" are coming, as we see, in such abundance that it will take several years before anatomists, in whose hands this rich material will now be put, have disentangled the numerous and striking affinities between so many different types which we have briefly enumerated. But geologists will also have a word to say about these discoveries, which raise again the very great question as to the long-since noticed affinities between the faunas of all southern continents and the presumed previous connection between those continents. Apart from all other considerations, the resemblance between the fossil marsupials of South America and the marsupials now living in Australia is so great that it is not possible to admit that forms so near to each other (and both so abnormal) might have developed independently upon two remote continents. It seems almost unavoidable to admit that some direct land connection has existed between South America and Australia, although all we know about the

* The Revista Argentina contains in its issue for December last a full description of the primates discovered by Carl Ameghino in south Patagonia. The connections which these fossils indicate between man, primates, ungulates, and rodents are of the highest interest.

persistence of the chief outlines of the continents seems to be opposed to the admission. Dr. Ihering, who has devoted a good deal of time to the study of the fauna of South America, boldly concludes from his own special researches that during the Secondary period a great continent extended from Chili and Patagonia, through New Zealand, to Australia, while the connection between South America and North America was broken during both the Cretaceous period and a great part of the Tertiary epoch. The striking differences between the faunas of both Americas, and the identity of many representatives of the faunas of South America and South Africa, make him also conclude that the two latter continents were connected as late as the Oligocene period.* R. Lydekker, whose opinion has such a weight in the matter, also concludes from the many known affinities between the fossil faunas and floras of the four great southern prolongations of the continental mass of the globe that they must have stood in a more or less intimate connection, and have been partially isolated from the more northern lands.† As to F. Ameghino, he also recognizes that, at least during the Oligocene times, South America was in direct connection with the Old World; but he points out the similarity of the mammalian and Dinosaurian faunas of both Americas, and concludes that the two continents must have been connected, as well as North America with Europe, at an earlier epoch.

It would be premature to attempt now the solution of this complicated question. It may be permitted, however, to point out that the hypothesis of a submerged antarctic continent is not improbable from the point of view of the physical geographer. The permanence of the continents, which is a fact, and seems to be opposed to the hypothesis, must be understood in a limited sense. In the equatorial and the two temperate zones we undoubtedly have huge continental masses, the great plateaus of Asia, both Americas, and Africa, which, so far as our knowledge goes, have not been submerged since the primary epoch; and around these backbones of the continents we have huge masses of land which have not been under the sea since the end of the Secondary period. But their outskirts have witnessed several retreats and invasions of the ocean, or of its Secondary period seas. Moreover, the permanence of the continents does not seem to extend to the circumpolar zones. When we consider the outlines of the two great plateaus of East Asia and North America, we see that these two great continents of the Secondary epoch

* Revista Argentina de Ciencia Natural, No. 4 (Sobre la distribución geográfica de los Creodontes, and letter to F. Ameghino).

† Nature, 1892, vol. xlvi, p. 12.

were narrowing at that time toward the north, and that their extremities were pointing toward some spot in the vicinity of what is now the Bering Strait, in the same way as South America, South Africa, and South Australia are now pointing toward the south pole. The great plateau of northeast Asia, which has remained a continent ever since the Devonian age, has so much the shape of South America pointing northeast that the resemblance is simply striking.* On the other side, we know that the Miocene flora discovered in Greenland, Spitzbergen, and New Siberia indicates the existence of a great Miocene continent where we now have but the ice-clad arctic archipelagos. So that we must conclude that, while the central (temperate and equatorial) parts of the globe really offer a certain permanence in the disposition and general outlines of their continents, the arctic region stands in a different position. It was under the ocean during a large part of the Secondary period, it emerged from the ocean and was occupied by a large continental mass during the Tertiary period; and now it is again under water. Such being the conditions of the arctic region, we may suppose that the same oscillations took place in the antarctic region as well. In such case, the two circumpolar regions would have been periodically invaded by the ocean (either alternately or during geological epochs closely following each other), and they would have periodically emerged from the sea in the shape of continents more or less indented by gulfs and channels. In short, a certain stability in the distribution of land and water in the equatorial and temperate zones, and unstability in the circumpolar regions (with, most probably, an unstable Mediterranean belt), would perhaps better express the observed facts than a simple affirmation of stability of continents. If these considerations prove to be correct—and I venture to express them only as a suggestion for ulterior discussion—then the hypothesis of a former more or less close land-connection between the southern extremities of our present continents would not appear unlikely, and the striking similarity between the faunas of Patagonia and Australia would be easily accounted for.

III.

Few branches of science have developed with the same rapidity as bacteriology during the last few years. The idea that infectious diseases are due to some micro-organisms invading the body of the infected animal is certainly old. It was ventilated many

* Petermann's and Habenicht's map of Asia, in Stieler's Hand Atlas (No. 58), shows this shape of the plateau better than any other map. For more details see my map in the Orography of East Siberia, in the Memoirs of the Russian Geographical Society, 1875, vol. v (Russian).

hundreds of years ago; and it was revived early in our century. But scientific bacteriology is of quite recent creation. It dates from the end of the fifties—that is, from Pasteur's researches into the fermentation of beer and wine and Virchow's investigations into cellular pathology. Progress has been very rapid since. We have now numerous works, large and small, devoted entirely to the description and study of the life-history of the microscopic organisms which occasion disease; and every year brings the discovery of some new micro-organism to which some disease, or group of diseases, may be attributed. Cholera, typhoid fever, gastric affections altogether, malaria, and influenza; tuberculosis, leprosy, and cancer; diphtheria, measles, and scarlet fever; rheumatism, anthrax, small-pox, rabies, and tetanus; nay, even the poison of the cobra snake,* have been traced to separate microscopical beings. The photograph of each separate bacillus or micrococcus may be found in the text-books; its manners of life, and very often its modes of reproduction, have been carefully studied, both in the animal body and in artificial cultures; so also its morbid effects when introduced into the bodies of various animals. True that the general reader is often amazed on learning that such and such a microbe which was introduced a few months ago, as the real cause of influenza or of some other disease, is recognized now as a common inhabitant of the human body, and has nothing to do with the said disease; while a few months later the real enemy will again be discovered, but will have no more success than its predecessor. But such ephemeral discoveries are simply indicative of an unhappily general tendency among modern scientists—that of hastening to announce discoveries, and to attach one's name to something new, before the supposed discovery has been submitted to the test of searching experiment. The same tendency prevails in all sciences—the only difference being, that the general reader is seldom gratified by the daily press with the discovery of a new chemical "law," or of a new "type" of fossil mammals, while each discovery which deals with disease, ephemeral or not, enjoys a wide publicity so soon as it has found its way into a scientific periodical. The very rapidity with which the would-be discoveries of new bacilli are reduced to their real value only proves, on the contrary, the safety of the methods used by bacteriology for distinguishing between the seeming and the real causes of disease.

We may thus safely recognize that science already knows a great number of micro-organisms which are capable, under certain circumstances, of producing certain specific diseases; and we

* M. Calmette, in Archives de médecine navale et coloniale, mars, 1892; referred to in Revue Scientifique, 23 avril, 1892.

may note that even those researches which, at the first sight, seem to overthrow established facts, only result in a deeper knowledge of diseases and their modifications. Thus, the recent investigations of MM. Lesage and Macaigne, who have finally succeeded in differentiating the typhoidic bacillus from the *Bacterium coli* —a microbe which is constantly met with in our intestines, and only under certain conditions acquires an especial virulence—are one of the best examples of how further research deepens our knowledge of microbes; and Dr. Cunningham's discovery of ten different varieties of the choleraic bacillus* certainly will have the same effect: it will simply widen our knowledge of the different forms assumed by cholera.

Things stand, however, quite differently with the means of combating infectious micro-organisms. Most of the specifics which once awakened so many hopes have proved in the long run to be as ineffective against bacilli as the specifics periodically proposed by allopaths and homœopaths are powerless against the diseases themselves. And the more the study of bacteria is advancing, the more it is recognized that a healthy body which is capable of itself putting a check on the development of morbid micro-organisms is the best means of combating them; that sanitary measures which prevent the very appearance of morbid germs are the surest means against the possibilities and the risks of infection. But what permits a healthy body to resist its invasion by morbid organisms? What gives several animals immunity against certain special diseases? Why do rats resist anthrax, and dogs and monkeys resist the tuberculosis of fowls, while the same microbes are fatal to rabbits and guinea-pigs? And how can immunity against certain diseases be acquired either by vaccination or by previously having suffered the same disease? We know the microbes; but what is it that renders them highly offensive in some cases, and quite inoffensive in some others?

Several theories have been constructed to explain the phenomena of immunity; and, although none of them has succeeded in dispelling all doubts, it must be recognized that each of them accounts for at least large groups of phenomena. In fact, of the two leading theories, one being purely biological, while the other pays its chief attention to the chemical aspects of the subject, they rather complement than contradict each other. The broadest and most ingenious of all explanations of immunity is the theory, elaborated in 1883 by Elie Metchnikoff, which represents an extension of the leading principles of struggle for life to the

* Scientific Memoirs by the Medical Officers of the Army of India, Part VI; analyzed in Annales de Micrographie, 1892.

microscopic constituents of the animal body.* Besides the cells which constitute the animal tissues, there are in the body of man and all vertebrates a number of free cells—the white corpuscles of blood and lymph and the wandering cells of the tissues—which exhibit all the characters of real amœbæ. Four different varieties of these amœboid cells, usually known under the general name of *leucocytes*, have been described—the distinctions between them being chiefly based upon the shape and the numbers of their nuclei; but the commonest form is that of a speck of protoplasm containing several nuclei which are connected by filaments of nuclear substance, as well as a little radiated sphere which plays such an important part in the bipartition of cells.†

The leucocytes of both the higher and the lowest animals have all the distinctive features of simple amœbæ. They protrude pseudopodia, and move about like amœbæ (only the smaller ones, usually described as lymphocytes, possessing this capacity to a smaller extent), and, like amœbæ, they are endowed to a high degree with the capacity of ingesting all kinds of small granules which they find in their way, such as grains of coloring matter suspended in water, and various smaller micro-organisms. It is very easy to observe how leucocytes of the frog, the pigeon, the guinea-pig, and so on, ingest bacilli by surrounding them with their protoplasm; and an immense literature, with illustrations by photographs and correct drawings, has already been published in order to show how various bacteria and micrococci are ingested by leucocytes. In some cases the thus ingested bacilli are *digested* —that is, transformed into a soluble matter which is assimilated by the protoplasm of the leucocyte, exactly in the same way as an amœba digests a diatom. In other cases the bacteria are for some time kept alive within the leucocytes, and if the leucocytes have been put into conditions which are unfavorable for themselves but favorable for bacteria, the latter develop, and are set free. It has also been seen pretty often that some bacilli propagate, by means of spores, within the leucocytes, or that the spores which have been kept for some time seemingly without life, begin to develop and give origin to a new generation of bacilli.‡

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* See his paper Immunity, in British Medical Journal, January 31, 1891. Also his last most attractive and profusely illustrated work, Leçons sur la Pathologie comparée de l'Inflammation, Paris, 1892, which can be safely recommended to the general reader, notwithstanding its rather technical title. Its subject is the struggle for life carried on within organisms by the amœboid cells against the microbes.

† See Recent Science in the Nineteenth Century, May, 1892, p. 758. The best morphological description of leucocytes is to be found in Ehrlich's Farbenanalytische Untersuchungen zur Histologie und Klinik des Blutes, Berlin, 1891, quoted by Metchnikoff.

‡ P. Netschajeff, Ueber die Bedeutung der Leucocyten bei Infection der Organismen, in Archiv für pathologische Anatomie, 1891, Bd. cxxv, p. 415.

These are facts, perfectly well proved, and confirmed by numberless observations made upon both the leucocytes of higher vertebrates and the amœboid cells of lower organisms. In fact, the whole first part of Metchnikoff's Leçons sur l'Inflammation is given to the description of like observations upon the ingestion and digestion of bacteria and other micro-organisms, and these observations are so conclusive that we already see growing a new science—comparative pathology—which will have to study the diseases and the means of defense against disease in all classes of animals. More than that. Not only those leucocytes which happen to be near to a microbe introduced within the body, do swallow it. It is now certain that as soon as microbes, or even some foreign substance like a splinter or coloring matter, is introduced into the body, the wandering white corpuscles of the body immediately move toward the foreign matter or organism, as if they were endowed with a certain irritability or sensibility, which directs their movements. This fact is so usual that Metchnikoff is even brought to advocate the idea that the distinctive feature of every inflammation is such a gathering of leucocytes around the infected spot, in order to destroy, if possible, the cause of infection. The defense of the living body by means of its phagocytes would thus be a fundamental character of all organisms, high and low, acquired and perfected during their evolution under the necessities of struggle for life.

However, not all bacteria are ingested by leucocytes. Thus, the leucocytes of mice (which so easily succumb to anthrax) do *not* swallow the anthrax bacilli; and those of pigeons and rabbits (who succumb to chicken-cholera) do not swallow the bacilli of that special disease. This fact has, however, nothing very astonishing in it, as it has its analogy in the life of the lowest organisms. Thus it has been proved that the plasmodium of the slime-fungi, or *Mycetozoa* (it occurs as a gelatinous mass on the surface of trees), which consists of numberless nucleated amœbulæ, and creeps by itself over the bark of the trees, most distinctly displays a certain option in choosing the direction of its movements. If cauterized at some spot of the part which moves foremost, it changes the direction of its motion, and leaves the cauterized spot behind. A decoction of dead leaves attracts it, while a solution of sugar or salt repels it.* The same is known of isolated amœbæ. So also the leucocytes immediately attack and ingest some microbes, living or dead, but avoid some others, and various kinds of leucocytes behave in various ways. The mono-nuclear leucocytes of man seem loath to attack the bacilli of erysipelas, while the many-nuclear ones display no such re-

* Metchnikoff's Leçons sur l'Inflammation, pp. 38 *et seq.*

luctance. Altogether, some substances exercise upon leucocytes a decidedly attractive power, while other substances repulse them.

As to what happens with microbes which have been ingested by leucocytes, the result may be very different in various conditions. The red corpuscles of blood, when ingested by leucocytes, are digested; globules of pus and fragments of muscular tissue also are digested by means of a special ferment (discovered in 1890 by Rosbach). And the same happens with microbes if the leucocytes of the organism are healthy and the animal is refractory to a given disease, either from natural causes or in consequence of vaccination. The bacilli of anthrax are undoubtedly destroyed by the leucocytes of the dog, as well as by those of such rabbits as have been vaccinated against anthrax. If the leucocytes are healthy, they prevent the germination of the spores which they have ingested; but they maintain this power so long only as they are healthy; because, if the animal has been submitted to cold (or to heat in the case of a frog), or if it has been narcotized,* it loses its immunity. Moreover, the very affluence of phagocytes to an infected place may be accelerated through nervous action, or slackened by various narcotics.

Such being the facts, it was quite natural to explain them, as Metchnikoff did, by maintaining that the phagocytes are the natural means of defense of organisms against infectious disease. The very necessities of struggle for life have evolved this capacity of the organisms of protecting themselves by sending armies of phagocytes to the spots attacked by noxious micro-organisms. The struggle may evidently end in either the defeat of the phagocytes, in which case disease follows, or the defeat of the microbes, which is followed by recovery; or, the result may be an intermediate state of no decisive victory on each side, as is the case in various chronic diseases. †

As to the force which attracts the leucocytes toward the microbes, it is already indicated by the extensive researches of the other school, which has devoted its chief attention to the chemical aspects of infection. It may be, as it is maintained by Mas-

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* E. Klein and C. F. Coxwell in Centralblatt für Bacteriologie und Parasitenkunde, 1892, Bd. xi, p. 464.

† Besides the powers of ingesting and destroying noxious granules, the leucocytes also contribute to the defense of the body by forming capsules around the granules, as well as by carrying them out of the organism through the skin. Transpiration is a familiar instance of the latter case. Mr. Herbert E. Dunham's observations on the Wandering Cells of Echinoderms and the Excretory Processes in Marine Polyzoa (Quarterly Journal of Microscopical Science, December, 1891), and Brunner's researches on transpiration (Berliner klinische Wochenschrift, January 23, 1892), are especially worthy of note under this heading.

sart, Bordet, and Gabrichevsky, that the leucocytes are attracted by the chemical poisons secreted by the micro-organisms; or the protein of the bacterial cells themselves may bring them on the spot, as is maintained by Buchner, who also has conclusive experiments in favor of his theory. Only further research will be able to decide which of these views is correct, and to what extent. But under the present state of knowledge the question can not be answered with certainty—the more so as Behring, Kitasato, Buchner, Emmerich, Vaillard, Tizzani, Cattani, Ch. Richet, and many others have weighty arguments in favor of the opinion that the immunity of animals depends upon some ferment-like albuminous substance contained in the serum of their blood. Strenuous efforts have been made of late by Koch, Buchner, E. H. Hankin,* and many others to come to some more definite knowledge of these "defensive proteins," which are known in science under the names of "alexines," "sozins," "phylaxins," and so on. But it will probably take some time before our notions about these substances take a definite form. One thing seems, however, to become more and more certain—namely, that the serum of the blood of immune or vaccinated animals, although in many cases it does not destroy the microbes themselves, is nevertheless possessed of a vaccinating power. This fact is settled beyond doubt; it is continually confirmed by fresh experiments; and it is recognized by the followers of the biological theory as well. As to its explanation, it may be sought for in the direction indicated by Metchnikoff—namely, that the serum, though not destroying the microbes themselves, destroys the poisonous substances which they are developing in the organism. In such case, organisms would be endowed with two means of defense instead of one; the two theories would naturally complete each other; and, may be, in some not very distant future they would enable man to combat with success some of the worst microscopic enemies of the human race.—*Nineteenth Century.*

A curious illustration of the indirect influence of the environment on human character is given in Mr. Greswell's Geography of South Africa, where it is observed that the indigenous woods of the country do not seem especially adapted for boat and ship building. The dearth of good ship-timber must partly account for the complete degeneracy of the Dutch colonists at the Cape as a seafaring people. With no good harbors at hand, with no navigable rivers, and no ship-timber for spars or masts, the change in their character and traditions as a maritime and fishing folk to a nomadic, pastoral, and continental people, might almost have been conjectured from the beginning. At the present time the up-country Boer has extremely vague ideas of the ocean and of all things.

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* See the reports of the last Hygienic Congress held in London, in September, 1891.

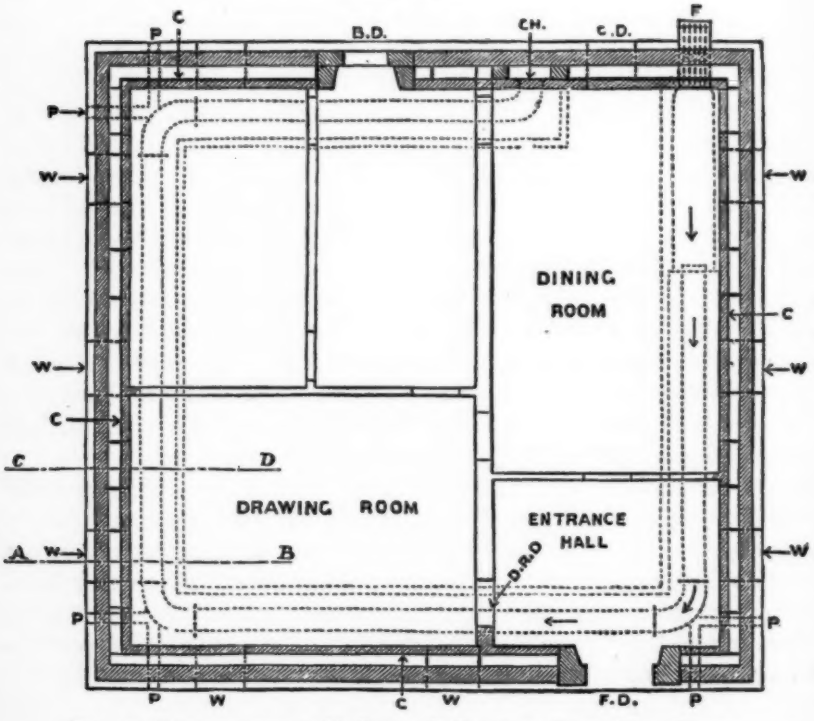
WARMING AND VENTILATING OF DWELLINGS.

THE best practical application of the principle of warm walls and cold air is undoubtedly the house which M. Somesco, civil engineer, has built for himself at Creil. We were fortunate in visiting M. Somesco on a day when a strong northeasterly gale was blowing. Wind creates greater difficulties than cold; but on this occasion we had both wind and cold. It is important to note that M. Somesco's house is built on marsh land. On both sides of the house there is a river, and but for the construction of embankments flood would constantly occur in this spot. It was necessary to dig six feet below the level of the cellar floor to find a foundation. As much masonry had to be placed under the house to form a foundation as would have sufficed to build it. The garden, in the midst of which the house stands, was also artificial. Nor is there any shelter from the winds. The house stands alone in the midst of what is now a garden, but which used to be a dismal swamp. The system of warming and of ventilation has therefore been tested under the most trying circumstances. In shape M. Somesco's house is square, measuring twelve metres. It has cellars, two floors, and above these under the roof a large sort of hall which serves as a billiard-room. The hollowed walls are fifty-five centimetres thick. The external wall is twenty-two centimetres and the inner wall eleven centimetres, so that there is an intervening space between the walls of twenty to twenty-two centimetres. These walls are made with porous bricks, but in the basement the walls are massive. The house is like one box inside another box, with a space of four to five inches between the two boxes.

Outside, at the back of the house, there is an ordinary coal-furnace. The smoke and heat from this furnace pass into a chamber built in the cellar of the house, measuring about six feet in length and not quite two feet square. From this heat-chamber and going all round the outer walls of the cellar there is an inclosed passage. Suspended in the center of this passage and also going the whole way round the house is a metallic flue of more than a foot in diameter (thirty-five centimetres internal and thirty-seven centimetres external diameter). This serves as a chimney and draws off the smoke and the heat from the furnace and heat-chamber, traveling horizontally round the four sides of the house; and then, when it is nearly back to the furnace, the flue opens into a chimney; the smoke and what heat remains go up vertically to the roof. In other words, the basement of the house is surrounded by a narrow closed passage, in the center of which is suspended the flue or chimney from the furnace, and

this flue serves to warm the air in this passage. To keep the cellar cool and to retain the heat that goes round the cellar, the wall of this passage is covered over with "sluck wool" or "silicate cotton," as it is sometimes called, which is considered a better non-conductor than asbestos. All round the house communicating with this hot-air passage there are inlets of fresh air from the garden, which measure eighty by fifty centimetres and are protected by metallic gauze or webbing. If the wind is very violent, a coarse canvas may be hung in front of these air inlets on the windward side of the house. There are ten such inlets, the fresh air being delivered, as will be seen in the sectional drawing A B, below the hot-air flue. The pipe or flue rests on iron bars and on a socket that permits the easy dilatation and

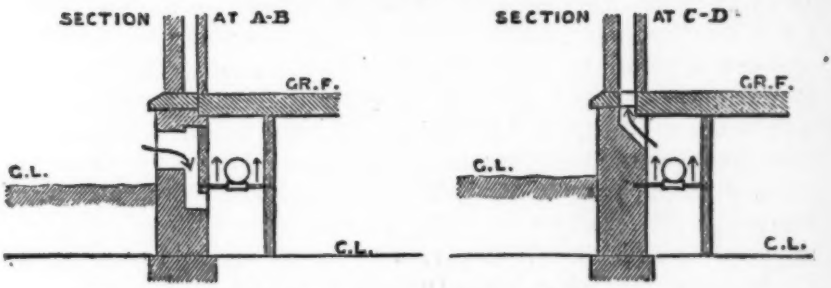
PLATE No. 1.



PLAN OF GROUND-FLOOR OF M. SOMESCO'S HOUSE AT CREIL, OISE, FRANCE.

The dotted lines indicate the warming flue passing down the center of the hot-air passage in the basement of the house. The plan gives the walls underneath the windows and indicates the space for hot air between the outer and inner wall. C C C, the arrows show the hot-air space between the walls. C D, the door from the garden into the basement. B D, the back door. F D, the front door. D R D, the door from the entrance hall to the drawing-room. F, the furnace lit in the garden outside the house. The arrows from the furnace indicate how the smoke and hot air pass horizontally round the house till they reach C H, where a chimney carries the smoke vertically up to the roof. P P P P, apertures through which brushes may be passed from the garden into the smoke-flue to clean away the soot. W W W W, position of the windows.

PLATE No. 2.



PLAN OF BASEMENT OF M. SOMESCO'S HOUSE AT CREIL, OISE, FRANCE.

Section A–B, showing inlet of air into the basement passage where the air is warmed. G L, the ground level of the garden. C L, the ground level of the basement or cellar. GR. F., the parlor floor, or first floor of the house. The inlet of air as indicated by the arrows is below the smoke-flue, which is suspended in the center of the passage, so as to warm the air in this passage.—Section C–D. G. R. shows the outlet of the air above the smoke-flue. The air warmed by contact with this flue passes upward in the intervening space between the inner and outer walls of the house, so as to warm the entire substance of the walls.

contraction of the iron with which it is made. The drawing C D shows how the air warmed in this passage ascends into the space between the two walls of the house. There are a number of these openings into the hollow of the wall all round the house.

The temperature in the hot-air passage varies from 114° to 122° Fahr. This suffices to bring up the temperature of the inner wall on the ground-floor from 86° to 92° Fahr. The temperature of the inner wall decreases by about one degree centigrade per metre of height. Thus, if the wall on the ground-floor level is at 35°, it will be 32° C. on the level of the first floor, which is three metres higher up. The hot air that travels up the hollow of the walls comes out in the large attic under the roof of the house. If this air is warmed to from 114° to 122° Fahr. when it enters the space between the walls it will have fallen to about 104° Fahr. as it emerges from the wall into the attic. From this attic the hot air filters into the open through the porosity of the roof and by the various openings, chinks, etc.

Much of the success of this experiment depends upon the porosity of the walls. Every precaution is taken not to interfere with this porosity. There is no plaster-work put on the walls, and there is no paint or paper. A light wooden frame is nailed on to the walls, and from this tapestry—that is, a tissue, as far as possible a woolen tissue—is suspended and replaces paper. Some hangings of this description can be obtained that are hardly any dearer than good paper, and though for artistic purposes expensive woolens are employed, the expense in the long run is not great, for the cloth lasts an indefinite time, and, unlike paper, can be taken down and cleaned. It also contributes very materially

to maintain the warmth of the walls. M. Somesco has now lived in this house for some years. Without the aid of fires, when the windows were shut, he has never known the temperature of the rooms fall below 54° Fahr., and this during the hardest frost. If the windows were thrown wide open the temperature indoors would not fall below 39° Fahr. in spite of the frost. The air coming through the windows is absolutely cold and frosty, but the thermometer rises under the influence of the heat radiated from the walls. There is a fireplace in each room, though fires are very rarely lighted. When, however, it is very cold weather and the windows have been open for a long time, then it is expedient to light a fire for an hour or so. As there is no loss of heat through the coldness of the walls, the room is warmed in a very short time. On the day of our visit the drawing-room windows had been open for two hours, and as the weather was very cold a fire was lighted, but soon the fire was let out, the room was too warm, the thermometer marking 78° Fahr. We left the drawing-room for some time. We opened the front door leading to the garden, and the drawing-room door, which was from four to five feet from the front door. Thus the fresh air from the garden blew freely into the drawing-room. Yet, and though there was now no fire, the radiation of heat from the walls was such that the thermometer marked 66° Fahr. In the garden the temperature was below 50° Fahr., and a strong northeasterly gale was blowing. Thus we were while indoors breathing cold, pure air from the garden.

We have seen that M. Somesco's house was built on a swamp; and yet the principal, if not the only, inconvenience from which he has suffered is extreme dryness. We visited other houses in the neighborhood and found the walls stained by the damp to a height of six or seven feet; some of M. Somesco's furniture and other objects were spoiled because the wood had split in consequence of its extreme dryness. To counteract this inconvenience, M. Somesco has been obliged to place a large number of plants in different parts of the house, a measure which, however, adds considerably to the charm and beauty of the place.

The heat and dryness thus secured cost M. Somesco ten tons of English household coals per annum. His house has fourteen rooms, and ten persons could live comfortably in it. The cost would then be one ton of coal per head per annum. But then it must be noticed that the furnace and the system of warming the passage round the basement of the house are somewhat roughly contrived, and that more economical methods of obtaining the necessary heat could be easily devised. Then it must also be noted that it is not a question of warming one room or a portion of a room, but that the entire house is equally warmed, and

warmed to such an extent that doors and windows are constantly opened, and this in spite of the exceptionally cold and damp nature of the surrounding soil and the exposed position the house occupies.

Over and above all these considerations M. Somesco maintains he has realized the ideal that a dwelling should be like our clothes, only not portable, but permeable. It should be warm, because it should be made of materials that are bad conductors of heat. Indoors we should possess means of counteracting the chilling effect of the outer air. We ought to live indoors as we live out of doors, and we should consider our house merely as if it were an extra great-coat. The coat, if porous, will be warm and healthy. One of the reasons, he says, why we are apt to feel uncomfortable when it rains is that the rain blocks up the porosity of the walls, and that, too, on the windward side. As for microbes, M. Somesco proudly pointed to the artistic drapery which covered the bare bricks of his porous walls. "These are," he exclaimed, "my microbe traps. If I have any reason to believe that injurious microbes have been introduced into my house, I know pretty well where to find them. It would take but little time or trouble to unhook all this drapery, to put it into the disinfecting stove, and there superheated steam under pressure, without injuring the cloth, would assuredly kill the microbes. Even without these artificial methods of purification, if the walls were porous, oxygen would go wherever the microbe went, and Nature would effect its own cure." How far a porous wall can filter and purify air, as earth filters and purifies sewage, is a matter which has not yet been investigated. He is of opinion that if we leave our walls alone, and do not block them up with paint and paper, we have for ordinary house walls in ordinary weather two cubic feet of air going through every square foot of wall in the course of an hour, and this is probably enough to insure the sufficient oxidation, if it goes on at all, of the materials of which the wall is made. Further, the porosity of the walls must also materially assist in the ventilation of the room which they surround. It was M. Somesco's delight to think that even when the doors and windows of his house were shut the pure air of his garden was blown upon him through the porous walls.

M. Somesco's house can, of course, only be taken as an experiment. The principles of which it is a practical application have not yet been adopted by the public. Already a private house is in the course of construction at Beauvais built on the same principles, and they are also to be applied to the military hospital at Madrid. To sum up these new theories and methods, the teachings of M. Trélat, the practical experiments of M. Somesco, suggest that the natural porosity of our walls, especially the outer

walls, should not be destroyed. These walls should be decorated, not with paper and paint, but with porous, non-conducting substances, such as woolen drapery. The outer walls on the side nearest to the inner surface should be hollowed throughout, thus constituting a double wall, with a space of about four inches between the two walls. A heating contrivance of whatever description may be found most expedient or economical should be placed in the basement of the house. A warm-air chamber or shaft traveling round the base of the outer walls should supply to the hollow in the walls air taken from the outside and warmed at the point of admission into the wall to a temperature of from 100° to 120° Fahr. This should maintain the temperature of the inner wall at from 80° to 90° Fahr. Then, he considers, the walls will radiate sufficient heat through the rooms to enable the inhabitants to constantly open the doors and windows, and to breathe cold, fresh, outer air without inconvenience. As a rule, fires will be unnecessary, dampness will be completely banished from the house, and to maintain some moisture in the air it would, he thinks, be expedient to decorate the house with numerous evergreen plants. The inhabitants should then be able to benefit by unlimited ventilation, and could breathe pure, cold, and fresh air coming upon them directly from the outside.—*Report of the London Lancet Sanitary Commission.*

THE address of T. Baldwin Spence, President of the Biological Section of the Australian Association, dealt with the fresh-water and terrestrial fauna of Tasmania, and the introduction of the present animals of Australia and the way their descendants had become distributed. The struthious birds—the ostriches, emus, cassowaries, and kiwis—were, with the exception of the African ostrich, which ranged into Arabia, confined to the southern hemisphere, while they were supposed to have originated in the northern hemisphere and migrated southward. But by this hypothesis there were great difficulties in explaining how the struthious birds reached Australia and New Zealand without being accompanied by placental mammals. Also, the struthious birds of New Zealand, including the lately extinct moas, were smaller, and made a nearer approach to the flying birds, from which the struthious birds were descended, than did any of the others, and they should expect to find the least altered forms near the place of origin. The tinamus of Central and South America, although flying birds, resembled the New Zealand struthious birds in several particulars; and as a former connection between New Zealand and South America was shown by the plants, the frogs, and the land shells, it seemed more probable that the struthious birds of Australasia originated in the neighborhood of New Zealand from flying birds related to the tinamus, and that they spread thence into Australia and New Guinea, rather than that they should have migrated southward from Asia. Probably the ostriches of Africa and South America have a different line of descent from the struthious birds of Australasia, and might have originated from swimming birds in the northern hemisphere.

SKETCH OF ALEXANDER WINCHELL.

WHILE he was industrious and versatile as an original investigator, Prof. Alexander Winchell was best known as a successful, instructive, and entertaining lecturer on subjects of science, especially of geology and evolution, and as the author of numerous books which have found their way into the households of our country, describing in a style interesting and comprehensible to all the latest results of research and of his own labors in those fields.

ALEXANDER WINCHELL was born in Northeast, Dutchess County, N. Y., December 31, 1824, and died in Ann Arbor, Mich., February 19, 1891. His family were in moderately comfortable circumstances. His father and mother had been teachers in the public schools of the town. He showed a taste for mathematics at an early age, which was illustrated by his having completed the first part of Emerson's arithmetic and his reciting the entire multiplication table without mistake on the day he was seven years old. When a little more than ten years old he had completed Willett's arithmetic, and had transcribed all the definitions, rules, problems, and full solutions in a manuscript book. He attended the Stockbridge Academy and the village school. It had been intended that he should study medicine, but on his expressing, when sixteen years old, a desire to teach, his father engaged a district school in which he taught during the winter of 1840 and 1841. As by-pursuits he collected and solved arithmetical problems, and began the practices, which he never discontinued, of recording the results of his reading and study, and keeping a diary and a strict account of expenditures. He continued his mathematical studies, soon acquired an enlarged idea of the preparation needed to fit him to become a doctor, became more attached to the profession of teacher, and had "his imagination fired" by the study of astronomy. In 1843 he became assistant in Amenia Seminary, where he had attended for a year as a student. Having entered Wesleyan University in 1844 as a sophomore, "he encountered with indignation," says his editorial biographer in the American Geologist, "the first check in his educational ardor and success in a rigorous 'marking system,' which at that time laid special stress on the literal reproduction of the words of the text-books." Though ambitious for honors, he refused to compete for them under those conditions. Having been graduated in 1847, he was appointed teacher of natural science in Pennington Male Seminary, New Jersey, "when he entered with irrepressible zeal and delight upon the study of the flora of the vicinity. The Morse telegraph having just come into operation, he attempted with suc-

cess, and with no special knowledge beyond the fundamental principles, the production of a working instrument, which he exhibited at a public lecture.

His ambition was now extending beyond mathematics. Declining offers of a tutorship in that science in Wesleyan University and of continued position in Pennington Seminary, he accepted the chair of Natural Science in Amenia Seminary. Here he gave his first public geological lectures; explored the flora of the vicinity, of which he contributed a catalogue to the regents of the university; observed solar spots; and began a series of meteorological observations.

He removed in 1850 to take charge of an academy at Newbern, Ala. Finding the prospects of the institution not equal to his expectations, he undertook to revive a suspended institution at Eutaw in the same county. Here he began a course of scientific investigations which he had been indefinitely projecting for some time. He communicated to the American Journal of Science notes on the cold of January at Eutaw, and on the aurora borealis of September 29, 1851; opened a correspondence with the Smithsonian Institution, to which he sent collections of plants, alcoholic specimens, and preserved skins, including the new species of fish, *Hybopsis Winchelli;* and communicated to the American Association in 1853 the first scientific description of the Cretaceous Choctaw Bluff, on the Black Warrior River. In 1853 Prof. Winchell became President of the Masonic University, Selma, Ala., and made a tour of the southern part of the State, to interest the people in the institution. The tour was also a geological one, and took him through a country rich in Cretaceous and Tertiary fossils, where Hippurites encumbered the ground and were burned into lime, and the "precious vertebræ" of Zeuglodon were used for andirons, stiles, and gate-weights. He sent a collection of fishes to the Smithsonian Institution, in acknowledging which Prof. Baird predicted that in not many years he would be called to a big professorship somewhere North or East. "Nine days after these words were penned," says his biographer in the American Geologist, "he was elected to a chair in the University of Michigan." This was in 1853; the professorship was that of Physics and Civil Engineering. He found on taking his chair, in January, 1854, that no good elementary text-books on civil engineering were in existence, and that he had to originate matter and methods. As a branch of physics he attended to the keeping of a complete series of meteorological observations, which, while he held the chair, he reported to the Smithsonian Institution. In the next year he was transferred, in accordance with an understanding that was had when he first went to the university, to the newly created chair of Geology, Zoölogy, and Botany. In a paper

On the Importance of the Study of Natural History, read before the State Teachers' Association in 1856, he advocated the introduction of that subject into the Union schools and the lower classes of the colleges. In the fall of 1857 he opened a class in comparative osteology. A geological survey of the State of Michigan having been ordered, he was commissioned as its director, and began, in 1859, with one assistant, the examination of the southern part of the lower peninsula. He fixed the position of the salt waters of East Saginaw to within two feet of their actual level, and in his report, published in August, 1861, fully anticipated the vast development of the salt interest in the Saginaw Valley. The official survey was suspended by the breaking out of the civil war, but the paleontological investigations were carried on privately. Prof. Winchell pointed out the gypsum bed near Tawas, which had been pronounced barren, but has proved marvelously rich; studied the "Marshall group" and its relations with the Chemung; investigated the cherry slug and currant worm; published numerous geological papers and an address on the soils and subsoils of Michigan, in which he insisted on the agricultural value of the pine lands; studied the oil-producing regions of the United States and Canada; and published a report on the Grand Traverse region, and a paper on the fruit-bearing belt of Michigan, in which attention was first called to the influence of Lake Michigan in ameliorating the climate of the State and prolonging the growing period. The Geological Survey of Michigan was reorganized in 1869, and Prof. Winchell was again appointed its director. He had learned much during the interval since the survey was suspended, as our enumeration shows, in his private travels for economical surveys, of the rock structure and physical features of the State. In 1871 he had prepared a preliminary report; but hostile political and personal influences had been working against him, and the appropriation for printing the report failed to pass the Legislature. He resigned his position, and the report, embodying the results of two seasons of field work in the lower peninsula, largely remains unpublished. A part of the material intended for it was condensed for Walling's Atlas of Michigan, and these memoirs were afterward collected in a volume, accompanied by topographical, geological, and isothermal charts.

In 1873 Prof. Winchell was called to the position of Chancellor of Syracuse University. He held it only for about one year, when the anticipated financial resources of the institution having shrunken considerably in the actuality, and he having been asked to take part in public efforts to augment the endowment, he resigned it. He had been told that the authorities of the institution had been attracted to him by his scientific reputation,

and that they wished him not to discontinue his pursuits in that line. He had, however, already found the presidency interfering with his scientific work, and the additional burden was too much. "For the duties of solicitor of money," says his biographer, "he had no qualification. Between paleontologist and financial agent was a gap so broad that he had never contemplated crossing it." He, however, in December, 1874, accepted the chair of Geology in the same university. For this department he prepared an extended syllabus of a proposed course of geological lectures, which should possess interest for the general public, but found it difficult in the financial condition of the institution to equip and maintain laboratories corresponding with his ideas of the professorship of Geology. While occupied with this problem, he was invited to become Professor of Geology, Zoölogy, and Botany, in Vanderbilt University, Nashville, Tenn. He accepted an engagement for three months, without severing his connection with Syracuse University, for he opened there a School of Geology, in January, 1876, which he wished to make a permanent feature of the institution; but the enterprise was not fully successful till 1878. He divided his time between Syracuse and Vanderbilt Universities. He found the authorities of the latter institution attached to the old ideas, and in no way disposed to give ear to the new theories of evolution. He nevertheless began his course under what might be considered favorable auspices. In 1877 he published a theory of a relation of meteorites to the disturbances of the satellites of Mars, and several papers in strictly orthodox books and newspapers, unfolding his theory of Preadamites, or of the existence of races of men before Adam; which, he held, was not contrary to divine revelation, but was authorized by a proper construction of the Scriptures. His views were kindly received, even when they were not believed, in the North, but were very unwelcome to his Southern friends. At the commencement season of Vanderbilt University of 1878, Prof. Winchell was warned that his "heterodox" position in reference to Preadamites and evolution was having an influence adverse to the interests of the university, and was asked to decline a reappointment to his professorship. He refused to do this on such grounds as were alleged. On the same evening he delivered one of the addresses of the commencement occasion; and on the next morning the Board of Trust of the university abolished his chair. It had been intended to have the thing quietly done, but Prof. Winchell published all the facts, and was not the one who suffered in reputation from the transaction. Of this incident, Dr. Andrew D. White says, in his New Chapters in the Warfare of Science: "That his lectures at the Vanderbilt University were learned, attractive, and stimulating, even his enemies were forced to admit; but he

was soon found to believe that there had been men earlier than the period of Adam, and even that all the human race are not descended from Adam. His effort in this was to reconcile science and Scripture, and he was now treated by a Methodist Episcopal bishop in Tennessee just as, two centuries before, La Peyrère had been treated for a similar offense by a Roman Catholic vicar-general in Belgium. The publication of a series of articles on the subject, contributed by the professor to a Northern religious newspaper at its own request, brought matters to a climax, for, the articles having fallen under the notice of the leading Southwestern organ of the denomination controlling the Vanderbilt University, the result was a most bitter denunciation of Prof. Winchell and of his views. Shortly afterward the professor was told by Bishop McTyeire that 'our people believe that such views are contrary to the plan of redemption,' and was requested by the bishop to quietly resign his chair. To this the professor made the fitting reply: 'If the Board of Trustees have the manliness to dismiss me for cause, and declare the cause, I prefer that they should do it; no power on earth could persuade me to decline.' 'We do not propose,' said the bishop, with gratuitous suggestiveness, 'to treat you as the Inquisition treated Galileo.' 'But what you propose is the same thing,' rejoined Dr. Winchell. 'It is ecclesiastical proscription for an opinion which must be settled by scientific evidence.' Twenty-four hours later Dr. Winchell was informed that his chair had been abolished, and its duties, with its salary, added to those of a colleague; the public were given to understand that the reasons were purely economic; the banished scholar was heaped with official compliments, evidently in hope that he would keep silence. Such was not Dr. Winchell's view. In a frank letter to the leading journal of the university town, he stated the whole matter. The intolerance-hating press of the country, religious and secular, did not hold its peace. In vain the authorities of the university waited for the storm to blow over. It was evident, at last, that a defense must be made, and a local organ of the sect, which, under the editorship of a fellow-professor, had always treated Dr. Winchell's views with the luminous inaccuracy which usually characterizes a professor's ideas of a rival's teachings, assumed the task. In the articles which followed, the usual scientific hypotheses as to the creation were declared to be 'absurd,' 'vague and unintelligible,' 'preposterous and gratuitous.'" While in Nashville Prof. Winchell constructed some pieces of microscopic apparatus and a small working steam-engine of one fifth horse-power, and completed a survey of the sanitary geology of that city.

In June, 1879, Prof. Winchell was unanimously recalled by the Board of Regents of the University of Michigan—a body that

was by no means united on most questions—to the professorship of Geology and Paleontology in that institution. He went back under much more favorable conditions for scientific advancement than had existed when he left the institution seven years before. "His duties at that time were spread over the whole field of geology, zoölogy, botany, museum and microscopical work. When he returned, the faculty embraced a Professor of Geology and Paleontology; a Professor of Mineralogy and Economic Geology; a Professor of Zoölogy; an Assistant Professor of Botany; an Instructor in the Microscopical Laboratory; and a Curator of the Museum—all of whose duties devolved upon one man in 1872." He began on his return to the university the preparation of an extended syllabus of a course of instruction in general geology, accompanied by copious references to sources of information. He presided over the Section of Anthropology at the Montreal meeting of the American Association. He spent the summer of 1886 in connection with the Geological Survey of Minnesota in field work in the extreme northern part of the State, north of Lake Superior. His work extended into twenty-four townships, where he noted and studied the outcrops at eight hundred and ninety localities, and he spent much time in the succeeding winter in the study for his first Minnesota report of the Archæan problems thus developed. The observations made in this survey were important, and were found to throw much light on some of the problems of Archæan geology. The plan of the next year's survey extended over the original Huronian area, and also over the iron regions of Michigan and Wisconsin and into the area of the Animikie in northern Minnesota. He entered into the study and discussion of practical questions touching the stratigraphic relations of the older terrenes and accumulated a large mass of data, the discussion of which he was never able to complete. He planned for a thorough discussion and examination of the data of the Archæan rocks, including their field relations and petrographic characters, and for the sake of it declined all but the most important invitations to lecture. In pursuance of this work he communicated to the eighteenth report of the Minnesota Survey (1889) a review of American opinion on the Presilurian rocks, and presented further results of his work in northern Minnesota at the Toronto meeting of the American Association. His last year (1890) was one of his busiest, and was occupied with lectures, attendance on scientific meetings, geological excursions, and the preparation of plans for enlarging the laboratory of the university. Prof. Winchell was a leading spirit in the formation of the Geological Society of America and in the establishment of the American Geologist.

His biographer in the American Geologist believes that Dr.

Winchell was perhaps the very first man of science in America "who descended before popular audiences from that high-caste and stately but dry and unpopular style in which the older scientists had thought it fit to cloak the dignity of science. . . . He simplified zoölogical themes rather than popularized them, and lifted up his voice only . . . where the select appreciators of science were numerous enough to constitute an audience." Societies for scientific culture, summer institutes, and similar organizations, formed a large part of the audiences.

Prof. Winchell was a voluminous writer. The list of his books and papers in the American Geologist includes two hundred and fifty-five titles. A predominant idea running through his Christian Theology illustrated from Nature was that of the harmony between the indications and doctrines of science and the central doctrines of the Christian religion. A similar thought ran through several other of his works. His Geology of the Stars and his World Life were attempts to extend the history of the earth as recorded in the geological strata so as to include the whole lifetime of a world, or to present, as he said in the preface, "a thoughtful review of the processes of world formation, world growth, and world decadence." Many of the thoughts in these works were so novel that he was not able to get an expression of opinion upon them from his fellow-students. A large proportion of his books are scientific treatises for popular reading—vivacious, suggestive, embodying the accurate results of scientific investigation, sparkling with original thoughts, and well adapted to their purpose.

The burden of his educational labor, according to his biographer, lay in the direction of widening the avenues of natural science and of its introduction into secondary schools. "He insisted that the young student is more observing than reflective or analytic, that the education of the mind should be by an appeal to its most accessible and most powerful impulses, and that the influence of science on the human mind, especially in its formative stage, is more healthful to a normal growth, more conducive to moral rectitude, and more stimulating toward a right ambition, than any other field of knowledge. . . . He believed that there is as much mental and ethical culture to be derived from the study of natural science, when pursued with equal thoroughness and exactness, as from the study of Greek or Latin literature or of mathematics."

EDITOR'S TABLE.

THE CLAIMS OF SCIENCE.

IN the present day, when so many schemes for the reformation of society are on foot, and so many experiments are being made in the treatment of social diseases, it is of the very first importance that the claims of science to an authoritative voice in human affairs should be faithfully and adequately presented. The efforts which such writers as Spencer and Huxley have made in this direction are known to all well-informed persons, but there is still room for the enforcement of the lesson, and we welcome the appearance of a new and vigorous champion of the good cause in Prof. Karl Pearson, author of the Grammar of Science, recently published in the Contemporary Science Series. There are many points touched upon in Prof. Pearson's book which might give rise to difference of opinion; but no one who is imbued with the true scientific spirit can fail to concur most heartily in what he says in his opening chapter as to the "claims of science."

The first claim of science is founded on the essential difference between scientific and unscientific opinion. "The classification of facts," says Prof. Pearson, "and the formation of absolute judgments upon the basis of this classification—judgments independent of the idiosyncrasies of the individual mind—is peculiarly the scope and method of modern science. The scientific man has above all things to aim at self-elimination in his judgments, to provide an argument which is as true for each individual mind as for his own. . . . The scientific method of examining facts is not peculiar to one class of phenomena and to one class of workers; it is applicable to social as well as to physical problems, and we must carefully guard ourselves against supposing that the scientific frame of mind is the peculiarity of the professional scientist." Not only is this method not that of the average man, but its very existence is scarcely surmised by him. His method—if such it can be called—of arriving at conclusions is to fasten his attention on a few salient facts, and to interpret them according to his own prepossessions and interests. If asked to take a point of view from which, perhaps, other facts would become salient, or to divest himself of self-interest as a canon of interpretation, he will in general decline; in many cases, indeed, he will be totally incapable of responding to the invitation. The idea of requiring a wide range of facts as a basis for induction, of checking the result of a first survey or examination by that of a second, third, fourth, or tenth, and of treating self-interest or previously formed opinion as a disturbing influence from which the judgment is to be kept as free as possible, is one which long ages of struggle with the problems of Nature have at length bequeathed to the scientific workers of to-day, but which has no lodgment, and but slight recognition, in the minds of the multitude. Prof. Pearson is, however, of opinion that an instruction in scientific method might be very generally imparted, and that its effect on the mind of the ensuing generation would be marked. He considers, very rightly, that a scientific frame of mind is an essential of good citizenship, seeing that it is that frame of mind alone which leads a man to look beyond proximate phenomena, and above all to put aside personal bias. It is the peculiarity, as he well observes, of scientific method that, when once it has become a habit of mind, that mind converts *all* facts whatsoever into science. Good intentions are not enough to make

a good citizen; a man may with the best of intentions, and even at great self-sacrifice, set himself in direct opposition to the best interests of the state. The trouble in such a case is that the man lacks knowledge, and, like an ignorant physician, either diagnosticates badly the evils he would remedy, or, if his diagnoses chance to be right—which is very unlikely—applies the wrong cure. Prof. Pearson does not pretend that as yet science can pronounce definitive and certain judgments upon all social questions; but he properly maintains that science should, as far as possible, be our guide to-day, and that it alone will ever lead us into a perfect comprehension of our social duties. We are, therefore, in full accord with him when he formulates what he calls the first claim of science in the following words:

"*Modern science, as training the mind to an exact and impartial analysis of facts, is an education especially fitted to promote sound citizenship.*"

The first claim of science being that it supplies the requisite *method* for dealing with social questions; the second, which flows naturally from the first, is that it brings actual principles to light which afford the most important guidance in social matters. Such Prof. Pearson holds to be Weismann's discovery—if it be one—of the non-inheritance of characteristics acquired during the lifetime of a parent organism. If Weismann's theory be correct, then, in Prof. Pearson's words, "no degenerate and feeble stock will ever be converted into healthy and sound stock by the accumulated effects of education, good laws, and sanitary surroundings. Such means may render the individual members of the stock passable, if not strong, members of society; but the same process will have to be gone through again and again with their offspring, and this in ever-widening circles, if the stock, owing to the conditions in which society has placed it, is able to increase in numbers. . . . If," our author significantly adds, "society is to shape its own future, we must be extremely cautious that, in following our strong social instincts, we do not at the same time weaken society by rendering the propagation of bad stock more and more easy." The argument under this head is not affected by the truth or falsity of Weismann's theory. If Weismann is right, we have to shape our conduct in such a way as to make the propagation of bad stock as difficult as possible, and we shall depend for the future welfare of society mainly upon a careful selection of stocks; if he is wrong, and stocks, no less than individuals, can be improved by education and outward circumstances, we shall apply ourselves more energetically to work in these directions. In either case, a verdict which science alone can render, is of the first importance in determining social action.

The third claim which Prof. Pearson makes for science is the obvious one that its suggestive discoveries afford means for the improvement of all the material conditions of human life. In the popular apprehension this is the one incontrovertible claim of science, and upon this point, therefore, it is not necessary to lay much stress. It may, however, be remarked that many of the greatest practical triumphs of science in the present age have flowed from discoveries or observations which at the outset it was hard to link, even in imagination, with any important practical result. In the words of our author, "The frog's legs of Galvani and the Atlantic cable seem wide enough apart, but the former was the starting-point of the series of investigations which ended in the latter." In like manner, it is suggested, the recent discovery of Hertz, that the action of electro-magnetism is propagated in waves like light, and that light, as conjectured by Maxwell, is only a special phase of electro-magnetic action, may in a generation or two do

more to revolutionize life than even the discovery of Galvani as developed in the electric telegraph.

In the fourth place, science, instead of repressing, as some erroneously believe, tends to develop the imagination. Our author puts the case well: "All great scientists have, in a certain sense, been great artists; the man with no imagination may collect facts, but he can not make great discoveries. If I were compelled to name the Englishmen who during our generation have had the widest imaginations and exercised them most beneficially, I think I should put the novelists and poets on one side, and say Michael Faraday and Charles Darwin." When facts have been accumulated and classified and their relations have been carefully traced, the next step is the discovery of some comprehensive formula which, conceived as a law or principle in nature, will sum up and explain the totality of the phenomena. This, as Prof. Pearson states, "is the work not of the mere cataloguer but of the man endowed with creative imagination."

Finally, science not only stimulates but disciplines the imagination and, with it, the æsthetic faculty. "With the growth of scientific knowledge," it is well remarked, "the basis of the æsthetic judgment is changing and must change. Many things in poetry and art which pleased our grandfathers, or even our fathers, are becoming to us, from our changed point of view, insipid and foolish. Many expressions that were part of the recognized stock in trade of poetry are losing, if they have not already lost, all their value for æsthetic purposes. It is not that our generation is growing less susceptible to beauty, but that it can not recognize as beauty that which is not felt to repose on the true." In the conclusion of his introductory chapter Prof. Pearson states that science endeavors to provide a mental *résumé* of the universe; and, though this great synthesis is not complete, and probably never will be, "it is better to be content with the fraction of a right solution than to beguile ourselves with the whole of a wrong solution"—words which we heartily echo. We do not think there is a point in this truly valuable chapter—the introduction to what is on the whole a most valuable book—on which we have not ourselves insisted at one time or another; but, as stated above, we rejoice at the appearance in the field of every new prophet of scientific truth. Prof. Pearson is not a new writer entirely, but in this work he appeals to a new circle of readers, to many of whom we have no doubt he will bring home a new and salutary conception of the place and function of science in the modern world. The battle of science seems to be nearly won, but overconfidence is always dangerous, and, as our author himself remarks, we see in our time "the highest intellectual power accompanied by the strangest recrudescence of superstition." Let the guardians and champions of truth be, therefore, unremitting in their vigilance and ceaseless in their efforts, till science has become to all mankind the symbol of blessing and of hope.

THE ROCHESTER MEETING OF THE AMERICAN ASSOCIATION.

Under the dignified and tactful presidency of Prof. Joseph Le Conte, of the University of California, the American Association for the Advancement of Science held a pleasant and profitable meeting at Rochester, August 17th to 23d. The University of Rochester placed its commodious buildings at the disposal of the Association; within a few paces stood open the doors of the Ward Natural Science Establishment; the nurseries, for which the city is famous, were of easy access; and in its Silurian outcroppings and glacial drift the vicinity had much to attract the geologist. In his address as retiring president, Prof. A. B. Prescott, of the University of

Michigan, showed how inseparable are pure and applied science in the field of chemistry, making a forcible plea for the endowment of original research. No laboratory work worth doing, he argued, can ignore laboratory work already done; study of the latest books, memoirs, and periodicals must go hand in hand with experiment. Nature is best known face to face, but the printed page is usually essential for the introduction.

In Section A, that of Mathematics and Astronomy, Prof. J. R. Eastman, of Washington, as vice-president, delivered an address on Neglected Fields in Fundamental Astronomy—in determining the absolute position of the stars. Interest in this section centered in the spectroheliographs taken and exhibited by Mr. George E. Hale, of the Kenwood Astrophysical Observatory, Chicago. These pictures mark a notable advance in the application of photography to astronomical research, the solar faculæ for the first time being clearly seized. In acquiring information regarding the earth, Mr. R. S. Woodward described how he had been able to approach accuracy within one part in five millions: in measuring the base-lines for the United States Coast and Geodetic Survey he had secured constancy of length in a standard bar by immersing it in melting ice.

In Section B, that of Physics, Prof. B. F. Thomas, of Columbus, Ohio, chose for the subject of his address as vice-president, Technical Education in Colleges and Universities. He held that their mathematical courses of education are usually too elaborate, are rarely drawn as they should be from practical examples, and ought as much as possible to be adapted to the special career the student means to enter upon. He noted with gratification how Stevens Institute was doing one thing well, and would rejoice to see other technical institutes each devoting itself to thorough education in civil, mining, and other distinct departments of engineering or other science. He commended literary studies and the art of clear and ready speaking. It is not so much what a man knows, he said, as the proportion of it that he can communicate, that makes him useful. Papers of value in this section discussed the sensitiveness of photographic plates, the photographic analysis of vowel-sounds, and a photographic mapping of the magnetic field. Interesting ascertainments of the distribution of energy in the spectra of the glow-lamp and the arc-light were also presented.

In C, the Chemical Section, the vice-president, Prof. Alfred Springer, of Cincinnati, spoke upon Micro-organisms of the Soil, indicating the important part they play in the chemistry of vegetation. Prof. H. C. Bolton, of New York, stated that his bibliography of chemistry, comprising ten thousand titles, is in press. Mr. Alfred Tuckerman, also of New York, read a brief note on a list of mineral waters, with analyses, which he is preparing for publication.

In Section D, that of Mechanical Science and Engineering, Prof. J. B. Johnson, of St. Louis, delivered an address on The Applied Scientist. Much attention in this section was bestowed upon instruments of precision and the difficulties attending their manufacture. Prof. W. A. Rogers, of Waterville, Me., had found the lack of homogeneity in even the highest grades of steel to be a grievous obstacle. Mr. J. A. Brashear, of Allegheny, Pa., stated that he had found a fortnight's labor necessary in bringing a plate two inches square to a satisfactory surface as a plane.

In E, the Geological Section, Prof. H. S. Williams, of Yale, the vice-president, gave a masterly address on The Scope of Paleontology and its Value to Geology. Prof. R. T. Hill, of Washington, read a paper on The Volcanic Craters of the United States, of much interest.

In Section F, Biology, Prof. S. H. Gage, of Cornell University, set forth The Comparative Physiology of Respiration, in his address as vice-president. Respiration, he said, is a mere mechanical help to enable oxygen to permeate living substance. Oxidation is not direct in the living tissue, as in a burning candle, but the tissue takes the oxygen and makes it an integral part of itself as it does carbon and other elements, and when finally energy is freed the oxidation occurs and carbon dioxide appears as a waste product. An animated debate in this section turned upon Weissmann's criticisms of the Darwinian theory that characteristics acquired during the individual life are transmitted to offspring. Prof. Manly Miles cited Dr. Dallinger's experiments in support of Darwin's view. These experiments, conducted continuously for seven years, had gradually brought micro-organisms, extremely rapid in their rate of reproduction, to enduring a temperature of 158° Fahr.; their normal temperature having been 60°. Prof. C. V. Riley remarked that most insects are born orphans; if they do not inherit characteristics acquired through the experience of their ancestors, how can they come into the world so richly endowed in aptitude and instinct, and what can so clearly difference the instinct of one insect from that of another? In this section the pressure of papers has of late years been so excessive that it was decided to divide the section in two: what in future will be known as Section F will take zoölogy for its field, and Section G (G being hitherto an unappropriated letter) will be devoted to botany. It is proposed that during each annual meeting a day shall be set apart for joint sessions, when papers occupying ground common to zoölogy and botany will be read and discussed.

In H, the Anthropological Section, Mr. W. H. Holmes, as vice-president, delivered an address on The Evolution of Æsthetics. Prof. F. W. Putnam outlined the archæological and ethnological exhibits to be presented under his direction at Chicago next year. He has a staff of some seventy explorers at work gathering anthropometrical statistics and collecting material. His reproductions of Indian settlements will represent aboriginal life in North, Central, and South America. The Canadian Government, through Prof. William Saunders, of Ottawa, will extend important co-operation; the New York State Commissioners for the World's Fair will provide an Iroquois stockaded village, with its characteristic long house of bark.

In the absence of Mr. S. Dana Horton, Section I, that of Economics and Statistics, chose Prof. Lester F. Ward as its vice-president. His thoughtful and provocative address treated The Psychological Basis of Social Economics. Economists, he said, have laid undue stress on the biological forces, the strictly individualistic aims, to be observed in human society. As intelligence and sympathy increase, the effect is that purely animal impulses are not simply qualified, but often reversed; competition steadily gives place to an ordered co-operation which, in the end, is much more gainful to all concerned than the first estate of universal conflict. The question as to what is best to be done with the municipal services which are in their nature monopolies, received some elucidation at the hands of Prof. E. W. Bemis, of the University of Chicago. He brought down to date his studies of municipal gas-works, maintaining that they had yielded substantial benefits as contrasted with works in corporate hands. Danville and Alexandria, Va., and Wheeling, W. Va., he said, operate their electric lighting as well as their gas supply municipally; and more than one hundred towns and cities in the United States own and manage electric-lighting plants.

The Entomological Club, which met concurrently with the A. A. A. S.,

heard an interesting paper from Mr. L. O. Howard, of Washington, detailing his plan of campaign against the mosquito. He employs kerosene spread as a thin film over the breeding-places of the insect; the oil remains efficacious for two weeks, and, as a little of it goes a long way, the cost is a mere trifle.

A capital lecture, fully illustrated, on Hypnotism, was given to the Rochester public by Prof. Joseph Jastrow, of the University of Wisconsin. Mr. C. K. Gilbert, of Washington, who discoursed on Coon Butte and Theories of its Origin, did not prove so interesting. It is perhaps in its endeavor in some measure to requite hospitality by its public lectures that the management of the Association is most open to criticism. Had popular elements in the Rochester programme received more attention, it is safe to say that the local accessions would have exceeded the small total of twenty-six.

Madison, Wis., was chosen for the next place of meeting, with Prof. William Harkness as president. The vice-presidents elected were: Section A, Mathematics and Astronomy, Prof. C. L. Doolittle, South Bethlehem, Pa.; B, Physics, Prof. E. L. Nichols, Ithaca, N. Y.; C, Chemistry, Prof. Edward Hart, Easton, Pa.; D, Mechanical Science and Engineering, Prof. S. W. Robinson, Columbus, O.; E, Geology and Geography, Prof. C. D. Walcott, Washington; F, Zoölogy, Prof. H. F. Osborn, New York; G, Botany, Prof. C. E. Bessey, Lincoln, Neb.; H, Anthropology, Prof. J. Owen Dorsey, Tacoma, Md.; I, Economic Science, Prof. William H. Brewer, New Haven, Conn. The probable time of the next meeting will be the week beginning August 19, 1893.

The Geological Society of America accepted an invitation to hold its winter meeting at Ottawa, Canada, December 28th–31st.

LITERARY NOTICES.

ESSAYS UPON SOME CONTROVERTED QUESTIONS. By THOMAS HENRY HUXLEY, F. R. S. New York: D. Appleton & Co. 1892. Pp. 489. $2.

Most of these essays were first printed from time to time in the Nineteenth Century, and afterward republished here in the Monthly. They were written, the author says, without premeditated purpose or intentional connection in reply to attacks upon doctrines which he holds to be well founded; or in refutation of allegations respecting matters lying within the province of natural knowledge which he believes to be erroneous. The circumstances of their origin gave them a polemical tone, the traces of which disappeared from his heart after the heat of controversy was over, but which he has allowed to remain as being most just on the whole to all, and especially as excusing the occasional severities his antagonists may have indulged in. The author's main thought in the papers has been to show that the events of the world and of life have been and are the outcome of a regular sequence according to fixed laws, and that the intervention of a supernaturalism on which much stress is laid by the "other side" is superfluous—not necessary, and not proved; not that he denies the existence of a supernaturalism, or of real powers and knowledge, equivalent to those which the supernaturalists predicate; for, "looking at the matter from the most rigidly scientific point of view, the assumption that amid the myriads of worlds scattered through endless space there can be no intelligence as much greater than man's as his is greater than a black beetle's; no being endowed with powers of influencing the course of Nature as much greater than his as his is greater than a snail's, seems to me not merely baseless, but impertinent. Without stepping beyond the analogy of that which is known, it is easy to people the cosmos with entities, in ascending scale, until we reach something practically indistinguishable from omnipotence, omnipresence, and omniscience. If our intelligence can in some matters surely reproduce the past of thousands of years ago, and anticipate the future thousands of years hence, it is clearly within the limits of possibility that some greater

intellect, even of the same order, may be able to mirror the whole past and the whole future; if the universe is peopled by a medium of such a nature that a magnetic needle on the earth answers to a commotion in the sun, an omnipresent agent is also conceivable; if our insignificant knowledge gives us some influence over events, practical omniscience may confer indefinably greater power." Thus the principle of scientific naturalism of this age "leads not to the denial of the existence of any supernature, but simply to the denial of the validity of the evidence adduced in favor of this or of that extant form of supernaturalism." The author here employs the words "supernature" and "supernaturalism" in their popular sense, but to him the term "Nature" covers the totality of what is. The world of psychical phenomena appears to him as much a part of Nature as the world of physical phenomena; and he is unable to perceive any reason for cutting the world into two halves, one natural and one supernatural. As all of the world's classics have been put to the test of scientific criticism and dissection, Prof. Huxley sees no reason why the Bible should escape the same treatment; and these essays, as our readers may recollect, discuss certain features of the biblical narrative from the point of view of scientific and experimental criticism. The author lays down a body of "established truths," which he specifies, to something like which theological speculations will have to accommodate themselves. These "truths" are irreconcilable with the biblical cosmogony, anthropology, and theodicy, but they are no less inconsistent with Voltairism and kindred systems. But Prof. Huxley is no enemy of the Bible. It appears to him that "if there is anybody more objectionable than the orthodox bibliolater it is the heterodox Philistine, who can discover in a literature which, in some respects has no superior, nothing but a subject for scoffing and an occasion for the display of his conceited ignorance of the debt he owes to former generations." Twenty-two years ago he pleaded for the use of the Bible as an instrument of popular education, but laid stress upon the necessity of placing the instruction in lay hands. He finds the further merit in the Bible that both Testaments "have been the great instigators of revolt against the worst forms of clerical and political despotism." While not believing that the highest biblical ideal is exclusive of others or needs no supplement, he does believe that "the human race is not yet, possibly may never be, in a position to dispense with it."

CHRISTIAN ANTHROPOLOGY. By Rev. JOHN THEIN. With an Introduction by Prof. CHARLES G. HERBERMANN, Ph. D., LL. D. New York, Cincinnati, Chicago: Benziger Brothers. Pp. 576.

THE author of this work is pastor of St. Martin's Roman Catholic Church, Liverpool, Ohio. Prof. Herbermann sets forth in his introduction that "the Church has taught for ages that between the truths of revelation and the truths of science there can be no conflict. The Vatican Council has solemnly repeated this teaching. On the other hand, some men famed for scientific learning and some famed for unscientific bluster proclaim that between faith and science no reconciliation is possible. Educated Catholics may well ask, How are such assertions possible? Still, it is not hard to find the explanation. If we could ascertain at once what are the truths of science and what are the truths of revelation, their comparison would end the controversy. But what are the truths of science?" Inquiring, the professor finds not the truths, but scientific opinion of what they are, vacillating and not wholly agreed. On the other hand, "we look to the Church to tell us what are revealed truths. . . . When the Church has spoken, we know what revealed truth is. But there are hundreds of opinions on dogma and morals which the Church has neither approved nor condemned, and thousands of biblical texts the meaning of which she has not defined." As it is not easy to find the truths of science or of revelation in every case, it is difficult to compare them with one another. When doctrines seem to be in conflict, it is well to inquire whether they have been established as truths by the Church on the one side or by science on the other; and it is not necessary to be troubled about conflict till this has been made to appear. Nevertheless, there are apparent conflicts, and "some scientific oracles" are doing their best with them to assail the dogmas of the Church. While the priests are informed only respecting one side, "difficulties, arguments

on a new discovery, on scientific phenomena, against revealed truth, present themselves sooner or later to every priest in the exercise of his ministry"; and "the priest who knows only his dogmatic and moral theology may be surprised and confounded by objections formulated in entirely new language, supported by pretended fact or by a discovery wrongly interpreted." Father Thein, who is said to be an enthusiastic student of science, to have given years of study and research to anthropology, and to have read the literature of the subject exhaustively, has undertaken in this book to inform his brother clergymen, so that they may not have to go into the conflict unarmed. He reviews the whole system of modern anthropological science and of evolution, with clear knowledge of what has been written and much force of argument. When he finds a weak point, he exposes it unmercifully, and is not above occasional sarcasm. His treatise is intelligent, good-tempered, and readable. But, because, while he questions science everywhere, he accepts the established dogmas of the Church as fixed, his work is better adapted to satisfy those young priests who want to be supported in what they are determined to believe than those inquiring minds who refuse to admit that the dogmas are beyond investigation.

THE PROCEEDINGS OF THE FIRST ANNUAL MEETING OF THE NATIONAL CONFERENCE ON UNIVERSITY EXTENSION. Compiled by GEORGE FRANCIS JAMES. Philadelphia: J. B. Lippincott Co. Pp. 292. Price, $1.50.

THE spread of the idea of university extension has been rapid, whether the results it has worked out have all been mature or not. Within a year after the first center of extension teaching was established in Philadelphia in November, 1890, Mr. James informs us, more than two hundred such experiments were being carried on in nearly every State in the Union. The results of the first year's work showed the need of thoughtful conference and discussion on the part of those engaged in it. Accordingly, a National Conference on the subject was called under the auspices of the American Society for the Extension of University Teaching, and met in Philadelphia in the last days of 1891. It was attended by delegates from twenty States, representing some fifty of the best institutions of learning, and—either personally or by written report—every center of extension teaching which had so far been established in the country. The seventeen addresses and papers made and read at the meeting, and contained in this volume of the proceedings, regard the subject from as many different points of view. In addition to them, reports are given of the condition and prospects of university extension in the several States.

MATTER, ETHER, AND MOTION. By Prof. A. E. DOLBEAR. Boston: Lee & Shepard. 1892. Pp. 334.

PROF. DOLBEAR has essayed to give, in this little volume of three hundred odd pages, a brief account of the fundamental notions of modern physics, and to show the direction in which the thoughts of those are tending who are endeavoring to understand the ultimate mechanism of what we have been accustomed to call dead matter. The title of his volume clearly indicates the trend of such thought. To the physicist the hypothetical ether, which Grove in the forties contemptuously referred to as the clothes-horse upon which to hang the unknown, is becoming more and more a very definite reality. It is to him much more than a working hypothesis. He assumes its existence, and is busily occupied in trying to understand its ultimate structure—that is, how it must be constituted in order to explain the phenomena with which he has to deal.

He sees in it now not only a medium for the transmission of the wave-motions which manifest themselves as light, heat, and electricity, but is attempting to find in it the explanation of matter itself. The old conception of the atom as simply an ultimate particle, itself dead and inert, but endowed with forces by means of which it acts upon other particles, is giving place to a radically different one. This conception is that of the vortex ring. Any smoker can make one, and they are frequently thrown from the funnel of a locomotive in starting. Such a ring consists of a circle of material, all the parts of which are in rotation in the planes of the radii of the ring. Physicists have conceived that such rings formed in the ether—this being postulated as homogeneous and frictionless—might constitute the ultimate some-

thing which we term the atom. Such a ring in such a medium would be indestructible, it would be elastic, and the size of the ring and its rate of motion would constitute the differences which we recognize between the elementary substances, instead of these differences being due to the size and shape of ultimate hard particles and their impressed forces.

In this view matter itself becomes but a mode of motion, and the old conception of forces as entities disappears. Everything is in the last analysis reducible to motion in the ether, and whether any given set of motions manifest themselves as heat, light, or electricity depends upon the character of the motions. The ether is at once the medium for the transfer of all motion and the storehouse of all energy.

Prof. Dolbear has set forth these new views of modern physics briefly but clearly, and without calling upon the reader for more knowledge than that possessed by the average cultivated man. He does not present them as demonstrated science, but as the views which are gaining ground among scientific workers, and which hold out the promise of our ultimately understanding, in some greater measure than now, the ultimate structure of the physical universe.

WATERDALE RESEARCHES; OR, FRESH LIGHT ON THE DYNAMIC ACTION AND PONDEROSITY OF MATTER. By "WATERDALE." London: Chapman & Hall, 1892. Pp. 293.

SINCE Newton first announced the law of gravity there have been innumerable attempts to formulate some working hypothesis of a mechanism by which the observed results might be produced. Newton himself repudiated the idea of the particles of matter acting upon each other through void space, and, though this conception of isolated particles endowed with attractive forces is commonly made use of in mathematical analysis, it has never been regarded by physicists as answering to any reality. They have recognized that the universe must be a plenum, and that gravity must in some way result from strains set up in a medium which fills all space. This view is now taking on more definite shape, and it is hoped that before a great while it may be possible to frame some intelligible and consistent theory of the operation of gravity.

To do this appears to be the purpose of "Waterdale" in these "researches," as he is pleased to call them. The book does not seem to have met with a very favorable reception in England, where it was published in the summer of 1891, and the author, therefore, prefaces the present volume with a wearisome plaint over his lack of recognition by scientific men. A dip into the book, which is all we have had time for, seems to amply confirm the judgment of the English scientific world. It may be that the author has arrived at some valuable ideas on the subject, but until he either puts them himself in readable English or has some one else do it for him he has not much cause for complaint if busy men refuse to spend time in hunting for the kernel of truth which may lie hidden.

ETHAN ALLEN, THE ROBIN HOOD OF VERMONT. By HENRY HALL. New York: D. Appleton & Co. Pp. 207.

THE purpose of the author of this work, who died, leaving it for his daughter to complete, was "to make a fuller life of Allen than has been written, and, singling him from that cluster of sturdy patriots in the New Hampshire Grants, to make plain the vivid personality of a Vermont hero to the younger generations." A picturesque hero he is made to appear. Had the records been less exact and romance been left to deal unrestrained with his career, he might in time have shone forth comparably with the most airy heroes of ancient myth and saga. He is compared with Robin Hood—that is, the Robin Hood of Ivanhoe—whose life was "an Anglo-Saxon protest against Norman despotism," as Allen's life was "a protest against domestic robbery and foreign tyranny." Although never a citizen of the United States, "he is one of the heroes of the State and the nation." While we find much about him to study profitably and admire, there are some features in his career that we can not unqualifiedly commend for imitation by our youth; neither can we censure him, for he acted according to his conscience, and consistently for a single end—the freedom of Vermont. He is best known for the capture of Fort Ticonderoga; but

what he would have considered his most important service was the defense of the New Hampshire Grants. This part of the story reminds us much of some of the scenes of the territorial history of Kansas. There is the same mixture of lawlessness and submission to the law that the Free State men showed there. It was a singular position the New Hampshire grantees were in, of acknowledging the political sovereignty of New York, and opposing with violence its conveyance of the lands they claimed by another title. The story is well told, largely in the words of the original documents. Another most curious feature in Allen's career is revealed in his coquetting with the British for the recognition of Vermont's position, even at the expense of the United States. As it is shown in this book, his conduct appears to have been controlled by sound reason. Congress had not recognized Vermont, and had refused to admit it to the Union. What claim had the Government on the allegiance of Allen or other Vermonters who were thus denationalized, and forced, as it were, to look out for Vermont alone? Allen was ready to negotiate with Great Britain or any authority that would secure Vermont's independent position—and that was all there was of it. The story of Allen's capture at Montreal, his captivity and imprisonment, is graphically told, wholly in his own words.

THE STONE, BRONZE, AND IRON AGES. A Popular Treatise on Early Archæology. By JOHN HUNTER DUVAR. New York: Macmillan & Co. Pp. 285. Price, $1.25.

As this book claims to be no more than a popular treatise, pains have been taken to give it that character. It is a fairly full treatise as to European archæology, but less so as to American, although most of the more important recent American work is mentioned. The subject is dealt with to date, and in a very satisfactory manner. The earlier chapters are occupied with the consideration of the geological periods as they relate to the appearance of man with animals in the Tertiary, and man in the Post-tertiary, the primeval condition of man, the mastodon and other animals contemporary with early man, and the presumed domestic life of nomadic man (as primitive man was supposed to be). The older stone or palæolithic age is characterized as the age of ponderous flint clubs. Two chapters are given severally to the cave-dwellers in Britain, and the cave-dwellers of other countries than Britain—in which notice is taken of American relics. Pursuing the subject, the author finds a gap in the scale of gradation between the close of the cave era and an advanced system of weapons in which light projectiles form the leading feature—the newer stone or neolithic age. This is described with considerable detail, both as to the weapons and the articles of domestic use, and is illustrated by a page of engravings of typical mound-builders' arrow-heads. The mound-builders have a chapter, and are supposed to have been of a civilization about equal to that of the Swiss lake-dwellers, and of no higher antiquity. A chapter each is devoted to the several topics of kitchen-middens; the age of bronze, pronounced the shortest of the three ages, the lake-dwellers, pottery, the iron age, sepulture (cairns, cromlechs or dolmens, barrows, etc.), fossil man, myth, and art. The author regards myth as not the invention of early man, but the fruit of a period of growth; and supposes that the works of art found among the relics, were the productions of specially gifted persons, of whom there may not have been more than one or two in an age, and that they can not be regarded as indicating any extended art sense.

MANUAL INSTRUCTION: WOOD-WORK (the English Sloyd). By S. BARTER. London: Whittaker & Co. New York: Macmillan & Co. Pp. 343. Price, $2.

IN this work, after an exposition of general principles in the introduction, information and instruction are given in drawing, the varieties, qualities, etc., of timber and other materials, bench-work, and the arrangement and fittings of the workroom—furnishing, among other things, the items of a complete equipment for a class of twenty boys. The chapter on bench-work contains twenty-three exercises in mechanical operations of wood-working, and thirty models of articles that may be made. A preface is supplied by Mr. George Ricks, who defines manual training as "a special training of the senses of sight, touch, and muscular perception by

means of various occupations; and it is a training of those faculties, not so much for their own sake, though that is important, as it is for the training of the mind. While the eye is being trained to accuracy and the hand to dexterity and manipulative skill, the mind is being trained to observation, attention, comparison, and judgment." The main object of this training is educational, to perfect the system of education, and so to raise the standard of practical intelligence throughout the community.

ESSAYS UPON HEREDITY, AND KINDRED BIOLOGICAL PROBLEMS. By Dr. AUGUST WEISMANN. Edited by EDWARD B. POULTON and ARTHUR E. SHIPLEY. Vol. II. The Clarendon Press, Oxford, 1892. Pp. 226. Price, $1.30.

THIS volume is made up from four essays upon the general subject of the title. In the first, Prof. Weismann describes the place and importance of retrogression in the development of animal life. The second essay deals with the musical sense in man and animals and its relation to natural selection. The third essay is controversial, and is an answer to certain criticisms of the views of Prof. Weismann on sundry biological questions. The last essay deals with the question of the reproduction of life, and is concerned with an attempt to understand the significance of the physical facts of the reproductive process. The work is addressed to students of biology, and requires acquaintance with the present state of biological inquiry to be read understandingly.

CONTRIBUTIONS TO NORTH AMERICAN ETHNOLOGY. Vol. II, in Two Parts. THE KLAMATH INDIANS OF SOUTHWESTERN OREGON. By ALBERT SAMUEL GATSCHET, and Vol. VI. THE CEGIHA LANGUAGE. By JAMES OWEN DORSEY. Washington: Department of the Interior.

THE monograph contained in the two large quarto parts of Volume II is a portion of the results of the Geographical and Geological Survey of the Rocky Mountain Region carried on under the direction of Major J. W. Powell. As described in Mr. Gatschet's letter of transmittal it deals with the beliefs, legends, and traditions of the Klamath Indians, their government and social life, their racial and somatic pecularities, and, more extensively, with their language. The group of Indians herein described comprises two chieftaincies, the Klamath Lake Indians and the Modoc Indians, the latter celebrated for their stubborn war with United States troops in 1872–'73. About a hundred pages in the first part of the monograph are devoted to an ethnographical sketch, the other seven hundred pages treating of the Klamath language and giving many Klamath texts. The whole of the second part is occupied with a dictionary having Klamath-English and English-Klamath divisions.

The language treated in Volume VI is the speech of the Omaha and Ponka tribes of Indians. Mr. Dorsey was a missionary to the latter tribe from 1871 to 1873, and resided with the Omahas from 1878 to 1880. The material of his monograph consists of myths, stories, and letters obtained from the Indians, with translations, both interlinear and consecutive. A dictionary and a grammar of the Cegiha language are in preparation.

MATHEMATICAL RECREATIONS OF PAST AND PRESENT TIMES. By W. W. ROUSE BALL. London and New York: Macmillan & Co. Pp. 241. Price, $2.25.

THIS is a book of curious interest, and, although the author confesses that the conclusions are of no practical use, and most of the results are not new, is not uninstructive. In the first of the two parts into which it is divided various problems and amusements of the kind usually termed mathematical recreations are described. In successive chapters are discussed questions connected with arithmetic, geometry, and mechanics; magic squares; and unicurval problems. In the second are discussed the three classical problems in geometry of the duplication of the cube, the trisection of an angle, and the quadrature of the circle, astrology, hypotheses as to the nature of space and mass, and the means of measuring time. Questions that involve advanced mathematics are excluded from both parts. Among the particular topics considered are the arts of coloring maps, of expressing conditions of physical geography by contour maps, games of position, the familiar "ferry-boat problems," geometrical puzzles, paradoxes on motion (sailing quicker than the wind, etc.), problems on force, inertia, work, stability of equilibrium, etc., perpetual motion, the boome-

rang, the puzzle of fifteen, the tower of Hanoi, Chinese rings, and the like; the knight's path on the chess-board, the art of traversing mazes, geometrical trees; the speculations on spaces of one, two, and four dimensions; and hypotheses concerning matter and gravity. Some of these problems are trivial; others are associated with the names of distinguished mathematicians; while several of the memoirs quoted have hitherto not been accessible to English readers.

THE ATLANTIC FERRY: ITS SHIPS, MEN, AND WORKING. By ARTHUR J. MAGINNIS. New York: Macmillan & Co. Pp. 304. Price, $2.

THIS is a book of general interest and considerable historical value. Many interesting articles on its subject have been published in various periodicals, but none that in themselves have covered the whole ground, and given, as the author says, an idea of the routine, forethought, and general arrangements necessary to carry on such a far-reaching organization as a great steamship line, and which would set forth the efforts of the men who have instituted and maintained such enterprises, and the nature and results of the more remarkable examples of vessels and machinery which they have employed. The effort has been made in this book to cover this ground; and the book gives the history, from the earliest institution of Atlantic steamers, of the several lines; chapters descriptive of the working, sailing experiences, and machinery of the Atlantic lines; notices of the men who have made and conduct the Atlantic ferry; sketches of eventful passages and scenes, etc.; facts concerning the manning, expenses, and cost of Atlantic lines; and Atlantic records and tables.

In the *Elementary Geography of the British Colonies*, published by Macmillan & Co. as one of their Geographical Series (price, 80 cents), the part relating to the British possessions in North America, the West Indies, and the southern part of the South Atlantic Ocean, is contributed by Dr. *George M. Dawson*, of the Geological Survey of Canada; and that concerning the colonies, dependencies, and protectorates in the northern part of the South Atlantic, Mediterranean Sea, Africa, Asia, Australasia, and Oceania is contributed by Mr. Alexander Sutherland, of Melbourne. India and Ceylon are not included, but are described in a separate volume of the Geographical Series. In both departments the descriptions are systematic, full, and satisfactory; and the geography is a valuable manual for whatever purpose such a work may be required.

In his book on *Electric Railway Engineering* (Rubier Publishing Company, Lynn, Mass.) the author, Mr. *Edward Trevert*, has endeavored to make the subject as plain and interesting as the present advance in the science will admit. The book is written wholly from an electrical point of view, and aims to make clear all the points connected with the management of electric railways. The power-house and its apparatus, generators, the construction of the line, motors, rheostats, electric heaters, trolleys, locomotives for heavy traction, trucks, car-wiring, and the storage-battery system are described and illustrated in the chapters severally assigned to them. Accounts are given of some illustrative roads, and remarks for motor men and station men; and some miscellaneous matters are treated of in the appendix. The author predicts a brilliant future for electric railroading.

We published a few months ago a paper by M. *Charles Henry* on *Odors and the Sense of Smell*, which included many facts and principles of great interest—some of them, doubtless, novel to most of our readers. Prof. Henry's full discussion of these subjects, with technical observations, tables, etc., which were not appropriate to a popular article, with descriptions of some special apparatus he has invented and applied, are given in a hand-book, *Les Odeurs; Démonstrations pratiques avec l'Olfactomètre et le Pèse-vapeur* (Odors; Practical Demonstrations with the Olfactometer and Vapor-Balance), which is published in Paris as a number of the Forney Municipal Professional Library of Art and Industry.

The *Etiology, Diagnosis, and Treatment of the Prevalent Epidemic of Quackery*—an address before the graduating class of a medical school—by Dr. *George M. Gould*, is devoted very largely to the denunciation of homœopathy. The offer of a prize of $100 is made for the best essay that shall, histori-

cally and actually, show up the ridiculous pretensions of modern homœopathic practice. Other medical "vagaries," like "Keeleyism," patent medicines, advertising, etc., are attacked with earnest vigor. Philadelphia.

A compendium of information is furnished by Dr. *P. C. Remondino*, concerning a region which is attracting much attention on account of its climatic advantages, in his book on *The Mediterranean Shores of America* (F. A. Davis & Co., Philadelphia, $1.25). The preparation of the book was suggested while the author was trying to unravel the intricate and contradictory information that is encountered in the study of climatology and its relation to the etiology of phthisis. Then he made a special study of his home climate, or rather climates, for he distinguishes seven kinds in southern California. The introduction is devoted to the discussion of generalities concerning the various features, several and collective, of climate, location, soil, altitude, exposure, sunshine, electrical conditions, etc., and is followed by descriptions of the several health resorts of the region and their peculiarities.

A book describing *The Chinese, their Present and Future; Medical, Political, and Social* (F. A. Davis, Philadelphia, $1.75), is by a Presbyterian medical missionary, Dr. *Robert Coltman, Jr.*, who became fascinated with the peoples of the far East, and particularly with those of China, by reading accounts of them in missionary journals and books. He was disappointed in his reading by a lack of detail and a meagerness of description, especially in regard to the social state of the people and country at present, and sought an opportunity to go and see for himself. Hence the book may be regarded as a labor of love. It gives a lively running account of what the author saw, experienced, and learned in northern China, throws many side-lights on the social conditions of the people of all classes, and adds chapters on the missionaries and their works, business opportunities, the present political situation of the country, and its future prospects.

The Hygienic Treatment of Consumption has been prepared by Dr. *M. L. Holbrook* to advocate the treatment of consumption by hygienic remedies, which are accessible to all who have the intelligence and the wisdom to acquire a knowledge of them and their application. It is methodical, and in the first part considers the nature and causes of the disease. Among the latter are the predisposing causes of various kinds, and the accidents which often result in consumption, and the micro-organisms as the immediate cause. The second and third parts discuss the prevention and treatment of consumption in its earlier stages and in more advanced cases. Most important of the remedies is enlargement of the chest and lungs, both as preventive and as curative measures in the early stages of the disease. They are secured through expansion by breathing, vocal culture, and a large number of physical exercises which are described. Food, clothing, the dwelling, horseback-riding, the will and will power, and many other physical agencies much neglected are discussed; also resting in the open air at various seasons and its advantages. The book is written mainly for the patient, who may select from the various remedies such as are more especially adapted to his needs. (M. L. Holbrook & Co., New York.)

Phases of Animal Life Past and Present (Longmans, $1.50) is the name of a collection of essays by R. Lydekker, which are intended to illustrate in a popular manner a few of the various modes in which animals —especially vertebrates—are adapted to similar conditions of existence; and also to demonstrate some of the more remarkable types of structure obtaining among the higher vertebrates. Special attention is given to the curious creatures of past geological ages, but living forms are not neglected. The animals described are classed as "mail-clad," "flying," "swimming," "primeval salamanders," "fish lizards" (short-necked), "plesiosaurs" (long-necked), "tortoises and turtles," "giant land reptiles" (dinosaurs), "flying dragons" (pterodactyles), "giant birds," "egg-laying mammals" (monotremes), "pouched animals" (marsupials), and "dogs and bears," followed by chapters on teeth and their variations, horns and antlers, and rudimentary structures. The style is clear and entertaining, the descriptions are specific, and the illustrations are excellent.

A book published by Putnams, on *Materialism and Modern Physiology of the Nervous System*, is the substance of an address that was delivered before the Philosophical

Faculty of Columbia College, by *William H. Thomson*. The author finds the expressions of modern physiologists on the connection between nerve and consciousness indefinite and unsatisfactory. He examines the development of the nervous system from the lowest vertebrates up to man, and discussing the questions at issue, concludes that there is that in consciousness and mental operations that can not be accounted for by nervous action alone, but something must be called in to assist; therefore matter, force, and consciousness are three distinct realities.

In *Architecture, Mysticism, and Myth* (Macmillan), a study is presented by *W. R. Lethaby* of the influence of Nature and men's ideas of the universe and of divinity on their art. The author distinguishes between the common use of the term architecture, which is rather applied to building, and the sense in which he employs it, as "the synthesis of the fine arts." "As the pigments are but the vehicle of painting, so is building but the vehicle of architecture, which is the thought behind form, embodied and realized for the purpose of its manifestation and transmission." The two are regarded as "quite clear and distinct as ideas—the soul and the body." Of these enumerated ultimate facts behind all architecture, which have given it form, the author studies particularly the influence of the known and imagined facts of the universe, the connection between the world as a structure and the building as a whole. His study brings him evidence "of a cosmical symbolism" in the buildings of the younger world, and of the intention in the idea of the temple "to set up a local reduplication of the temple not made with hands, the world temple itself." Beginning with the form of the world in the first chapter of his study, the three or four chapters that follow deal with the relation of the building to it as a whole, and the rest of the work with parts and details. The book is an interesting one, the argument is reenforced with citations from mythology and folk lore, and the whole is appropriately illustrated.

In *Philosophy and Physical Science*—an inaugural address as professor in Adalbert College—*Mattoon Monroe Curtis* turns the tables on the champions of scientific culture, and sets forth the claim that "philosophy is the central discipline about which all others cluster, and by which they are to be estimated; that upon the great problems of physical science there is at present little ground for sweeping generalizations and rigid dogmatisms; that principles of faith are the foundations of all our beliefs concerning external realities; that the speculative elements in physical science are its most prominent and necessary features; and that in all speculative questions wisdom commands honesty, moderation, and charity."

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POPULAR MISCELLANY.

Scientific Work of Rochester, N. Y.—A large part of the address of Mayor Curran, of Rochester, to the American Association on its meeting in that city was devoted to the scientific record of the city. While the people showed their mental activity in numerous material applications and business enterprises, he was also able to point with pride to the advances made in scientific research by certain of the population, quietly and without ostentation. The Rochester Microscopical Society was organized in 1879, and has become the largest in the United States. From this beginning sprang the Rochester Academy of Science in 1881. It was divided into twelve sections, including anatomy, astronomy, botany, entomology, conchology, hygiene, ichthyology, infusoria, literature, microscopy, photography, and taxidermy. Its establishment gave a great impetus to scientific work, and afforded the citizens a clearer conception of what was being done. Among individual cultivators of science, Mr. H. C. Maine, editor of a daily paper, has distinguished himself by his careful observations of the sun, carried on through many years, and his theories as to the connection

between solar disturbances and terrestrial meteorology. He has successfully photographed the sun and the moon with instruments of his own manufacture, and has gained fame as a microscopist by his arrangement of diatom test plates. Mr. Lewis Swift, another astronomer, "for years, while engaged in the occupation of hardware merchant, devoted every clear night to his favorite study, perched upon an apple-barrel on the near-by flat roof of a rickety cider-mill. Here, while inhaling the pure air of heaven from above, mingled with the fumes of acetic and pomic acids from below, he scanned the skies night after night with an absurdly inferior instrument. But perseverance and love for the science, in the absence of a well-equipped tower, urged him to discovery after discovery, forcing the great astronomers of the world reluctantly to acknowledge the power and genius of the man on the cider-mill." He has been the first discoverer of ten comets, the last one a most remarkable one with twelve tails, and has observed nine hundred and seventy new nebulæ. Rochester is the home of Prof. Ward, the learned biologist, whose labors and undertakings in behalf of science are well known in both hemispheres. It was there, too, that Lewis H. Morgan, anthropologist, lived, labored, and died. The University of Rochester some years ago began teaching anthropology to a small class; other institutions followed the example; but "to this university belongs the credit of having introduced or added in America this important branch to its curriculum." Side by side with scientific labor in the city has grown an optical manufactory which holds a position peculiarly its own. In short, scientific activity has taken deep root in Rochester, and "is there to stay."

The Temperature of the Brain.—From observations made upon animals under various narcotics or anæsthetics, and man, with an instrument capable of detecting changes of not more than 0·002° C., Prof. Moso has found that, as a rule, the temperature of the brain is lower than that of the rectum, but that intense psychical processes or the action of exciting chemical substances may cause it to remain 0·2° or 0·3° higher. An ordinary interrupted current causes a rise in the temperature, which is observed earlier in the brain than elsewhere. Observations made on an animal when awake seem to show that the development of heat due to cerebral metabolism is considerable, and that the mere maintenance of consciousness belonging to the wakeful state, apart from all intense psychical activity, involves considerable chemical action and consequent change in temperature. But the variations of temperature as a result of attention, or of pain or other sensations, are very small; and when an animal is conscious no change of consciousness, no psychical activity, however brought about experimentally, produces more than a slight effect on the temperature of the brain.

Roasted Potato-pulp.—A new method of preparing and preserving potatoes—to be fed to cattle or to be made the basis of dishes for the table—has been devised by M. Aimé Girard, of the Conservatoire des Arts et Métiers, Paris. The potatoes having been ground, the pulp is exposed to pressure for the exclusion of all the water that can be removed by mechanical means. The pulp is then sliced and heated in a furnace till it is entirely dried, at a temperature high enough to give it a pleasant taste, without being so high as to convert the starch into dextrin. The substance thus prepared is called by the inventor torrefied pulp, and is suitable for feeding to cattle. With boiling water it forms a palatable soup; ground and mixed with wheaten or rye flour it forms a good breadstuff.

Saxon Musical Instruments.—According to the report of the Turkish consul at Leipsic, the making of musical instruments has been from time immemorial the occupation of the mountain villages of Klingenthal, Georgenthal, Upper and Lower Lachsenfeld, and Gera, in Saxony, and the instruments are exported to all countries. Musical machines—aristons and orchestrions—are made in Leipsic itself at six factories. Some of the manufacturers in the country at large are famous, like Herr J. Bluthner, who has bought large forests in Galicia and Poland, so that he can provide his own woods. The factories do much work for tropical countries, whither they send instruments the inner parts of which are chiefly of iron. The manufacture of German organs, harmoniums,

and accordeons is a specialty of Gera. The manufacture of physical, optical, and medical instruments is one of the special occupations in the forest of Thuringia. For many years the people of Ilmenau, Mauebach, and Stutzerbach have devoted themselves almost entirely to the construction of thermometers, barometers, baroscopes, and hygrometers. Whole families are engaged in the work; and children are set upon it from a very early age. It is a surprising sight, on roads distant from the centers of trade, to see whole trains of wagons loaded with physical instruments. The products of this manufacture are much appreciated in Germany. Their construction is perfect; their accuracy is guaranteed by a royal commission at Ilmenau; and many of the universities and doctors supply themselves directly from the country.

Snails of Mountain and Plain.—The influence of the medium on variation has been specially studied by M. A. Locard in the case of land-mollusks, or snails. First among these elements considered is altitude. It seems a simple matter, but is really complicated, and includes among other elements those of temperature, light, ventilation, and food resources, the respective actions of which are hard to separate. The author takes them all in one. The same species of snails are often found at the level of the sea and in the mountains. But the number of individuals greatly diminishes as the altitude increases, under the influence, apparently, of the variations in certain vital conditions. There are species, however, so well adapted to life in elevated situations that they do not thrive elsewhere. The *Helix alpina*, for instance, lives only in the mountains. Though individuals of the species readily and constantly stray into the valleys, they do not form stocks there. As between the species of the mountains and of the plains, the former are smaller, and have thinner and plainer colored shells. With increase of heat, below the degree of intensity at which existence is threatened, the size increases. Many species attain double the size they reach in France, while species transported from Algeria to France shrink to one fourth the dimensions they have in their native habitat. The character of the shell is affected by variations in the soil. Calcareous districts are rich in mollusks, while those in which the soil is silicious are poor in them, and the animals themselves are smaller and less vigorous. The difference may be experimentally verified by feeding half a lot of snails upon plants growing in sandy ground and the other half with plants from calcareous soil; a great difference will be perceived in the size of the shells.

Size and Shape of Rain-drops.—Mr. E. J. Lowe has made more than three hundred sketches of rain-drops, and has gathered some interesting facts respecting their variation in size, form, and distribution. Sheets of slate in a book form, which could be instantly closed, were employed. These were ruled in inch squares, and after exposure the drops were copied on sheets of paper ruled like the slates. Some drops produce a wet circular spot; while others, falling with greater force, have splashes around the spots. The same drop varies considerably in the amount of water it contains. The size of the drop ranges from an almost invisible point to at least two inches in diameter. Occasionally large drops fall that must be more or less hollow, as they fail to wet the whole surface inclosed within the drop. Besides the ordinary rain-drops the author exhibited to the Royal Meteorological Society diagrams showing the drops produced by a mist floating along the ground, and also the manner in which snow-flakes, on melting, wet the slates.

Geographical Work of 1891.—In his annual address as President of the Royal Geographical Society Sir Montstuart E. Grant Duff, reviewing the incidents of the geographical exploration accomplished during the year, noticed Mr. Merzbacher's work in the Caucasus and Mr. Howell's ascent of Oraefa Jökull in Iceland as the chief mountaineering feats. In Asia military exploration had gone on steadily on the northern frontiers, and the society was making efforts to have the results of such work made more accessible to the public. Lord Lamington's journey in the Shan states, and Captain Bower's and Dr. Thorold's adventurous crossing of Thibet also opened up new ground. In Africa, Mr. A. E. Floyer crossed the Egyptian Desert from Assouan to the Red Sea; and in the region of the Great Lakes Cap-

tain Lugard, Emin Pasha, Dr. Stuhlman, and the late Father Schynse have added to our knowledge. The Italians have been energetic in exploring Somaliland, and the French, despite the disaster to M. Crampel, have not abandoned their efforts to reach Lake Tchad from the west. Captain Gallwey and Mr. Gilbert T. Carter have made important discoveries in Lagos and Benin. Mr. Bent's well-known exploration of Zimbabwe, and Mr. Joseph Thomson's study of Lake Bangweola, which ill-health still prevents him from writing up, are the most important pieces of work in South Africa. Sir William MacGregor has been very active in opening up British New Guinea.

The New Element Masrium.—The probable existence of a new element is reported in the *Chemiker Zeitung*. It occurs in a mineral which was discovered in 1890 by Johnson Pasha in the bed of one of the dried-up old rivers of Upper Egypt—a fibrous variety of a mixed aluminum and iron alum containing ferrous, manganous, and cobaltous oxides; in addition to which is a small quantity of the oxide of another element, having properties different from those of any yet known. The supposed element has been named *masrium* (Ms), from the Arabic name for Egypt, and the mineral masrite. Its atomic weight has been approximately determined at 228, which nearly corresponds with the number (225) for which an element is wanted by the periodic system in the beryllium-calcium group. The monoxide has been obtained, and several salts.

Personality in Animals.—We are accustomed to take but little account, says *Le Monde de la Science et de l'Industrie*, of the possession of a sense of personal responsibility by animals, but if we look carefully into the matter we shall find that it is an important trait among many of them. Many animals know how to impose rules of conduct upon themselves, to assign themselves duties, and to observe them. Their females attend to the wants of their young before securing their own provision of food; the sentiment of the relations of command and obedience is obvious in social animals, like monkeys, deer, elephants, buffaloes, and birds of passage. The shepherd-dog controls the flock that is intrusted to his care with as much authority and self-confidence as his master himself. The imposition of restrictions upon themselves exists among animals to the extent that is necessary for the maintenance of their health. Capacity to adapt its work to the laws of Nature is perceptible in the bird building its nest, as it is in the architect who is constructing a monument. The fox is a skillful constructor of the kind of burrow best adapted to its needs. All these animals exercise a precise action upon their medium for a definite purpose. Dogs seem to have complete consciousness of their existence, and their slightest actions accord with that view. They hunt with as much ardor as men, and seem to take a genuine interest in incidents of the expedition; they prance with joy when successful, and drop their tails after failure. What right have we to deny them consciousness? The rudiments of what we regard as the real bases of personality certainly exist, in a more or less marked degree, in even the inferior animals. If man is a person and derives rights and duties from the fact, so also, to a certain extent, are the elephant, the dog, and the fox, each in its way. It is easier to talk about the gulf that separates man from the other animals than to measure it.

Soldering Metals to Glass.—According to the Pharmaceutical Record, an alloy of ninety-five parts of tin and five parts of copper will connect metals with glass. The alloy is prepared by pouring the copper into the molten tin, stirring with a wooden mixer, and afterward remelting. It adheres strongly to clean glass surfaces and has the same rate of expansion as glass. By adding from one half to one per cent of lead or zinc, the alloy may be rendered softer or harder, or more or less easily fusible, as required. It may also be used for coating metals, to which it imparts a silvery appearance.

Age of the Central American Monuments.—As a result of his studies of the monuments of Central America and Yucatan, Mr. Alfred P. Mandelay announces in Nature the conclusions that the southern ruins, including Palenque, Copan, and Quirigua, are much more ancient than those of Yucatan, and were probably in full decay before

the Spaniards entered the country; while in Yucatan, where the Spaniards first came in contact with Indians who used stone as a building material, some of the ruined structures now to be seen were inhabited by the natives at the time of the conquest. The author believes that the civilized portion of the Maya race have at some time occupied all the country lying between the Isthmus of Tehuantepec and the western frontiers of Honduras and Salvador, excepting perhaps a strip of country along the Pacific seaboard; that this people spoke the same or nearly allied languages, which they wrote or carved in the same script; that they were followers of the same religion; and that they built stone-roofed temples and houses decorated with the same class of design and ornament. At the time of the Spanish conquest they had abandoned their towns and religious centers south of Yucatan, though from the present condition of the mines it could not have been many years before; while in Yucatan, where they probably still occupied some of the buildings, they were in a state of decadence, and many of the larger centers of population had been abandoned, although the more important religious edifices may still have been reverenced and kept in repair. The early Spanish writers speak of large numbers of books written and preserved by the natives of Yucatan. They were written in the Maya language, and in characters called hieroglyphical. The Spaniards destroyed all of these books they could, thinking them the work of the devil, but copies of three of them escaped, and are preserved in European museums. The characters in which they are written are similar to those of the inscriptions on the monuments; and both are believed to be in a language that is still living and spoken in the region, although it has probably been much changed in the course of years.

The Sargasso Sea.—A theory of the Sargasso Sea is proposed by M. Krümmel, different from that of Humboldt, which was based, he avers, on less complete observations than we have now. This sea is in the form of an ellipse with the major axis nearly following the tropic of cancer. Around the principal ellipse are other larger ones, in which the vegetation is not so thick, and the forms of which are affected by prevailing winds. M. Krümmel believes that the sea-weeds come from the shore regions of the Gulf of Mexico, the Antilles, Florida, and the Bahamas, and not from the bottom of the sea, as was formerly supposed, and is in this supported by recent observations of the Gulf Stream. This current is now believed to be the resultant of numerous currents coming from the Antilles, and therefore to carry a much larger quantity of sea-weed than was formerly supposed. These sea-weeds reach the Sargasso region in about fifteen days after they enter the Gulf Stream. They are carried slowly onward toward the Azores till they become water-logged and sink, to give place to others.

Secular and Periodic Changes in Latitude.—A committee appointed by the American Association to secure data with regard to secular and periodical changes in latitude, reported that the investigation could best be made in a method suggested by Prof. S. Newcomb, of observations at three stations somewhere near the same parallel of latitude, but in widely different longitudes; the observations to be extended over a sufficient interval of time to secure the elimination of any effect arising from the recently discovered short-period variations in the latitude. Such a series of observations, followed after an interval of from ten to twenty years by another similar series, would furnish suitable evidence on the subject. It seems advisable also to utilize as far as possible some of the older determinations of latitude at American stations, particularly the Bond-Peirce determination at Cambridge in 1845 and the earlier Coast Survey determinations. New observations are already promised at Cambridge and Washington. The more detailed recommendations of the committee, in harmony with these views, were approved by the Association.

Remedies for Defective Color-vision.—A committee of the Royal Society appointed to consider the question of testing for defective color-vision has made a report recommending that a schedule be made of employments in the mercantile marine and on railways, the filling of which by persons whose vision is defective, or who are igno-

rant of the names of colors, would involve danger to life and property; that the testing should be compulsory, and intrusted to examiners certificated by the central authority; that Holmgren's test be used for color-vision, and that after passing it the candidate be required to name without hesitation the colors that are employed as signals or lights, and also white light; that rejected candidates have a right of appeal; that candidates rejected for naming colors wrongly who are proved to possess normal color-vision be allowed to be re-examined after a proper interval of time; that certificates of the qualifications of candidates be given, and schedules of the results of examinations be sent up every year; that persons filling the scheduled employments be examined every third year for form-vision; that the tests, etc., be inspected periodically; that signal colors of ships and railways be as far as possible uniform; and that witnesses in judicial inquiries arising out of these matters be themselves tested for color and form vision.

A Curious Accident by Lightning.—A singular wholesale effect of a stroke of lightning occurred at Bourges, France, on the 4th of May. A detachment of soldiers was hastening to get under shelter from an approaching storm, when the whole body were thrown by the lightning upon their faces. One man, who was a little distance away and in the rear, was also affected, but not so seriously. Most of the men rose immediately, but four remained prostrated for a little while, and one was killed. The men say they felt violent blows in the nape of the neck and the legs, and a sensation of burning. None of the men saw the lightning, except an officer in front, who was facing them.

Types of Indian Beauty.—In an interesting paper on Indian Types of Beauty, Dr. R. W. Shufeldt has collected portraits, with personal descriptions, of specimens representing several tribes of the Southwest, including a Navajo man and his wife Anserino; Izashima, a belle of the Laguna Pueblo; the daughter and the wife of Paliwahtiwa, governor of Zuñi; a girl of Moqui; Natuende, an Apache maiden; Sowatcha and Luli-pah, married Mojave women; and a Yuma squaw. The Yumas never have as good-looking women among them as are to be found among the Mojaves; and, in the author's opinion, "the prettiest and most intelligent faces of all are possessed by the young unmarried girls of the pueblos."

Kerosene as a Preventive of Mosquitoes.—Mr. L. O. Howard, of Washington, read an interesting paper before the Association of Economic Entomologists in Washington, on averting the mosquito plague by treating the breeding-spots of the pests with kerosene. He gave the details of some accurate experiments made during the first part of July, which indicated that ninety-six thousand square feet of water can be covered by one barrel of kerosene, at the cost of $4.50. The effect of the treatment is that the eggs and early stages of the mosquito are destroyed, and all the female mosquitoes alighting upon the surface of the water for the purpose of laying their eggs will be killed. The deadly effects on insects of such application will remain for at least two weeks, and will outlast all evidence by the smell of the presence of kerosene.

NOTES.

A COMMITTEE of five members, chosen from different sections, was appointed by the American Association to act with the corresponding committee of the World's Congress of the Columbian Exposition respecting such matters as may appropriately come under its cognizance.

THE report of the American Association's committee on indexing chemical literature recommends that communications be entered into with the Royal Society, so that a perfect index can be prepared. It was decided to appoint a committee to secure a certain number of experts to work on the index which is to be published by the Smithsonian Institution.

THE credit for the introduction of manual training into the public schools is claimed by Director J. L. Tadd, of the Public Industrial Art School of Philadelphia, for Mr. Charles G. Leland, who was chiefly instrumental in influencing the board to make the first attempt. Mr. Leland was a skilled handworker as well as literary man, and had a complete idea of the practical side of the question as well as of the theoretical. The teachers in the Philadelphia school think

the results in their general studies are improved by the relaxation and change given by manual-training work in and between their own studies.

PROF. W J MCGEE adduced a considerable number of reasons at the Niagara Falls Excursion of the American Association for supposing that the recession of the Falls from Lewiston to their present position has occupied about seven thousand years—he regarding Prof. N. H. Winchell's estimate of seventy-eight hundred years as probably the best. "On comparing this estimate with the march of the secular seasons," he says, "a remarkable coincidence is observed; for, since the longitude of perihelion is now 99° 30′, the middle of the last Platonic winter, which is now just past in the southern hemisphere, occurred seventy-one hundred years ago. This coincidence strengthens the suggestion of interdependence between cosmic and terrestrial conditions, and affords a basis for comparing the natural time-unity of the astronomer with the semi-arbitrary periods of the geologist; and so the date of the last ice invasion recorded in the moraine-fringed glacial deposit may be provisionally fixed at seventy-one hundred years ago."

IN his address before the Anthropological Section of the American Association on The Evolution of the Æsthetic, Mr. W. H. Holmes maintained that creations of art are growths the same as are the products of Nature, and are subject to the same inexorable laws of genesis and evolution. The several branches of æsthetic art—painting, architecture, sculpture, music, and the drama—were reviewed, and their growth and evolution illustrated in support of this thesis.

THE American Association decided to ask Congress for a reduction of the tariff on scientific instruments and periodicals; also to ask it to take steps for the preservation of the ancient ruins which are situated on Government lands.

DR. H. MOLISCH, after investigation of the subject, denies that iron is present in chlorophyl, having never found a trace of it in that substance. He says that iron occurs in plants in two forms—in that of ordinary iron-salts, and in the "masked" condition, in which it is so closely combined with organic substances that the ordinary reagents fail to detect it. In this form iron occurs both in the cell-wall and in the cell-contents, but does not enter into the living protoplasm.

THE experiments of Mr. A. J. Cook, of the Agricultural College of Michigan, appear to show that bees require eleven pounds of honey to enable them to secrete one pound of WAX.

THE statement of Mr. George F. Kunz, that the hardness of diamonds is not perceptibly reduced by cutting and polishing, is confirmed in Science by Mr. W. A. Rogers, of Colby University, who has had much experience in ruling with diamonds.

ACCORDING to a paper by T. Forster, of Amsterdam, the bacteria which produce the light of phosphorescence are able to multiply and develop at the freezing-point of water. They not only live in the sea, but are met with in brackish and fresh water, upon victuals, manures, etc. This agrees with the fact that victuals kept for some days in an ice-chamber gradually assume a disagreeable smell and taste; and that meat can be preserved from putrefaction for days, but not for weeks. If foods are to be preserved at a low temperature for a long time, besides cold, a second element is necessary—dryness.

DR. H. J. TYLDEN, of England, has recently died of typhoid fever, after having been engaged in investigations of the etiology of the disease—in which, it is supposed, he contracted it. He had recently published an article in Nature on The Bearing of Pathology upon the Doctrine of the Transmission of Acquired Characters.

A WILD-FLOWER exhibition—the fourth of the kind—was recently held in Edinburgh, Scotland, and is described by Mr. W. R. Lazenby in Garden and Forest. It comprised seventeen hundred entries, including hand-bouquets, baskets, bouquets of heather and thistles, of heather and bluebells, of wild grasses, of white heather, of wild ferns in rustic baskets, wreaths of wild roses and honeysuckles, collections of dried wild flowers and of dried leaves of native trees tastefully mounted, crosses of wild flowers, and window flower-boxes. All, with the exception of the last class, was the work of children. The exhibition is given under the auspices of a juvenile paper of the city.

A CORRESPONDENT of the London Spectator tells of a horse in India which lately defended its master and saved his life against a murderous attack made upon him. Lieutenant Robertson, of the Engineers, when out riding, was joined by a Ghazi—which is Oriental for champion—entered into a friendly conversation with him, then into a race—and beat him. The Ghazi then attacked the English officer with his *tulwar* and inflicted a severe gash upon his neck. "When Lieutenant Robertson fell off his horse, and was lying on the ground bleeding profusely, the faithful animal protected his master from further injury by kicking at the Ghazi and attempting to bite him. But for this remarkable behavior on the part of Lieutenant Robertson's horse, it is supposed that the Ghazi would have probably hacked Lieutenant Robertson to death." The Ghazi was seen by two Indian boys, was caught and identified, and sentenced to be hanged.

INDEX.

ARTICLES MARKED WITH AN ASTERISK ARE ILLUSTRATED.

PAGE

Abbott, Charles C. Delaware Indian, The, as an Artist.* 586
Accidents, Incalculable. W. A. Eddy 666
Adams, John Coleman. A Chapter in Meteorological Discovery 787
Adams, John Couch, Sketch of. (With Portrait) 545
Agriculture, Energy as a Factor in. M. Miles 87
Air, Bad, and Bad Health. H. Wager, and A. Herbert 97
Air, Liquid, and Liquid Oxygen. (Misc.) 714
Allen, Grant. A Desert Fruit 109
Almond Culture in California. H. J. Philpott 328
Aloe, American, Flowering Habit of the. (Corr.) G. Pyburn 413
American Association, The Rochester Meeting of the (Editor's Table) 846
Ancient Civilization, The, of America. J. S. Newberry 187
Animal Friends, Miss North's. (Misc.) 428
" Versatile. (Misc.) 718
Animals, Miss North and her. (Misc.) 571
" Personality in. (Misc.) 861
Anthropological Work in America.* F. Starr 289
" " in Europe.* F. Starr 54
Anthropology at the World's Fair. (Misc.) 561
" Value of the Applications of. (Misc.) 570
Assertion, Power of. (Misc.) 140
Atmosphere, Variety of Motions in the. (Misc.) 713

Barrel-making. (Misc.) 562
Bartram, William, Portrait of. (Misc.) 561
Beaulieu, Anatole Leroy. State Intervention in Social Economy 463
Bibliolatry, The Decline of. T. H. Huxley 594
Biological Physiology. (Misc.) 285
Birds, Stronghold of. (Misc.) 284
Bolles, Frank. Ways of the Owl.* 313
Bolton, H. Carrington. Historical Notes on the Gold-cure 464
Books noticed 127, 268, 416, 553, 702, 849

Allen, H. Addresses on Anatomy, 135.
American Journal of Morphology, vol. v, No. 3, 422.
Armstrong, J. E., and J. H. Norton. Laboratory Manual of Chemistry, 558.
Aulde, J. Pocket Pharmacy, 273.
Bacon, B. W. Genesis of Genesis, 128.
Bailey, L. H. Cross-breeding and Hybridizing, 706.
Baldwin, Joseph. Psychology applied to the Art of Teaching, 704.
Ball, W. W. R. Mathematical Recreations of Past and Present Times, 854.
Ballance, C. A., and W. Edmunds. Liga-

Books noticed:

tion of the Great Arteries in Continuity, 128.
Barnes, A. Agriculture of South America, 708.
Barter, S. Manual Instruction: Woodwork, 853.
Beardmore, W. L. Drainage of Habitable Dwellings, 708.
Benedict, W. R. Psychological Table, 709.
Black, G. A. History of Municipal Land Ownership on Manhattan Island, 424.
Bolton, H. C. Scientific Correspondence of Joseph Priestley, 130.
Bottone, S. R. Guide to Electric Lighting, 419.
Brinton, D. G. Studies in South American Native Languages, 707.
Brockney, F. J. Essentials of Physics, 274.
Bryant, W. M. World-energy and its Self-conservation, 556.
Carlyle, Thomas. Last Words of, 555.
Cheney, S. P. Wood-notes Wild, 424.
Chisholm, G. G., and C. H. Leete. Longmans' New School Atlas, 705.
Ciaffi, F. Baratto dei Biglietti di Banca, 706.
Citizens' Money. A. B. Westrup, 425.
Claus, C. Elementary Text-book of Zoölogy, 131.
Colbert, E. Humanity in its Origin and Early Growth, 708.
Coltman, R. The Chinese, their Present and Future, 856.
Columbia College. Report of the President, 1891, 421.
Comstock, T. B. Resources of the Central Mineral Region of Texas, 134.
Connecticut Agricultural Experiment Station, Report, 421.
Cowperthwait, J. H. Money, Silver, and Finance, 557.
Creighton, C. History of Epidemics in Britain, 554.
Crosby, O. T., and L. Bell. The Electric Railway in Theory and Practice, 129.
Curtis, M. M. Philosophy and Physical Science, 857.
Davies, C. Elementary Algebra, 423.
Davies, N. S., Jr., M. D. Consumption; how to Prevent it, and how to Live with it, 423.
Denning, D. Art and Craft of Cabinet-making, 274.
Dolbear, A. E. Matter, Ether, and Motion, 851.
Dorsey, J. O. The Cegiha Language, 854.
Douglas, C. A. Financial History of Massachusetts, 425.
Duvar, J. H. The Stone, Bronze, and Iron Ages, 853.
Encyclopédie Scientifique des Aide-mémoire, 420.
Engineering and Mining Journal. Mineral Statistics for 1891, 423.
Evans, T. American Citizenship, 275.
Falkener, E. Games, Ancient and Oriental, 556.
Fernow, B. E. Timber Physics, 708.
Findlay, G. Working and Management of an English Railway, 271.
Fisher, A. B. (Buckley). Moral Teachings of Science, 268.
Fiske, J. Discovery of America, 416.
Flick, T. Three Circuits, 419.
Flower, W. H. Horse, The, 270.
Flügel, E. Thomas Carlyle's Moral and Religious Development, 134.
Food, Monthly, 706.
Fraenkel, C. Text-book of Bacteriology, 128.
Fryer, J. Chinese Scientific and Industrial Magazine, 273.
Gage, S. H. Microscope and Histology, 134.
Gatschet, A. S. The Klamath Indians of Southwestern Oregon, 854.
Geography, Elementary, of the British Colonies, 855.
Good Roads. I. B. Potter, Editor, 422.
Gordon, H. L. Feast of the Virgins, and other Poems, 424.
Gould, G. M. Etiology, Diagnosis, and Treatment of the Prevalent Epidemic of Quackery, 855.
Gouley, J. W. S. Diseases of the Urinary Apparatus, 272.
Greer, H. Recent Advances in Electricity, 132.
Greswell, W. P. Geography of Africa South of the Zambesi, 706.
Griswold, W. M. Descriptive List of Romantic Novels, 132.
Hall, H. Ethan Allen, the Robin Hood of Vermont, 852.
Hellyer, S. S. Principles and Practice of Plumbing, 269.
Hempel, W. Methods of Gas Analysis, 274.
Henry, C. Les Odeurs, 855.
Holbrook, M. L. The Hygienic Treatment of Consumption, 856.
Hudson, W. H. Satan of Theology, 135.
Humanity and Health. E. A. Jennings, M. D., Editor, 423.
Humanity's Spreading Curse, 709.
Huxley, T. H. Essays upon some Controverted Questions, 849.
Illinois. Report of the State Entomologist, 1889, 421.
Indiana Agricultural Experiment Station. Report, 421.
International Prison Congress, Fourth, 422.
James, G. F., compiler. Proceedings of the First Annual Meeting of the National Conference on University Extension, 851.
Jew, The, at Home, 558.
Journal of Comparative Neurology. C. H. Herrick, Editor, 419.
Journal of Physiology. M. Foster, Editor, 422, 707.

Books noticed:

Journal of the College of Science, Tokyo, 134.
Journal of the United States Artillery. Quarterly, 424, 708.
Kirkpatrick, T. J. Modern Cook-book, 132.
Lacroix-Danliard. Le Poil des Animaux et les Fourrures, 422.
League of American Wheelmen Roads Improvement, 132.
Le Favre, C. Delsartean Physical Culture, 132.
Lethaby, W. R. Architecture, Mysticism, and Myth, 857.
Logan, C. How to Reduce your Weight, or Increase it, 430.
Lovett, R., and C. Davison. Elements of Plane Trigonometry, 274.
Lydekker, R. Phases of Animal Life, Past and Present, 856.
McCalley, H. Coal Measures of Alabama, 133.
Maginnis, A. J. The Atlantic Ferry, 855.
Manual of American Water-works, 131.
Marble, A. P. Sanitary Conditions for School-houses, 275.
Marshall, A. Elements of Economics of Industry, 560.
Marshall, A. Principles of Economics, vol. i, 270.
Massachusetts Agricultural Experiment Station. Ninth Annual Report, 421.
Massee, G. Plant World, The, 558.
Maxwell, James C. Treatise on Electricity and Magnetism, 705.
Maynard, C. J. Manual of North American Butterflies, 706.
Merrill, F. J. H. Quaternary Geology of the Hudson River, 134.
Meyer, L. Outlines of Theoretical Chemistry, 559.
Miller, E. Evolution of Love, 275.
Missouri Botanical Garden. Report, 1892, 707.
Money. Essays in Economics. J. Borden, 425.
Naegeli, C., and S. Schwendener. Microscope, The, in Theory and Practice, 557.
National Educational Association. Journal of Proceedings and Addresses, 1891, 559.
National Museum. Report, 1889, 555.
Natural Science. Monthly, 418.
Nebraska Agricultural Experiment Station. Report, 421.
New England Meteorological Society. Investigations, 1890, 709.
New Jersey Experiment Station. Report of the Botanical Department, 133.
New Jersey Geological Survey. Report, 1891, 709.
New World, The. Quarterly, 424.
Newell, J. H. Outlines of Lessons in Botany, 554.
Not on Calvary, 559.
Notes on Beauty, Vigor, and Development, 420.
Papers in Penology, 132.
Parsons, J. R. French Schools through American Eyes, 707.
Pickering, E. C. Preparation and Discussion of the Draper Catalogue, 423.
Pilling, James C. Bibliography of the Algonquian Languages, 703.
Philosophical Review. J. G. Schurman, Editor, 418.
Physical Education, 706.
Ralph, J. Along the Bowstring, 420.
Ramsey, S. English Language, The, and English Grammar, 560.
Redding, Jacob. Physiology: its Science and Philosophy, 707.
Remondino, P. C. The Mediterranean Shores of America, 856.
Robinson, J. Our Trees, 134.
Rochester Academy of Science. Proceedings, vol. i, "Brochure" 2, 422.
Rotch, A. L. Observations made at the Blue Hill Meteorological Observatory in 1889, 423.
Scott, A. Introduction to Chemical Theory, 557.
Semple, C. E. A. Elements of Materia Medica and Therapeutics, 709.
Sidgwick, H. Elements of Politics, 269.
Smithsonian Institution. Report, 1890, 555. Report, 1891, 131.
Solms-Laubach, H. Graf zu. Fossil Botany, 558.
Spencer, H. Social Statics, abridged and revised, 553.
Stephens, C. A. Pluri-celluiar Man, 707.
Strahan, S. A. K. Marriage and Disease, 702.
Sullivan, J. W. Direct Legislation by the Citizenship, 131.
Taylor, F. M. Right of the State to be, 132.
Taylor, J. T. Optics of Photography and Photographic Lenses, 275.
Thein, John. Christian Anthropology, 850.
Thomas, C. Prehistoric Works East of the Rocky Mountains, 133.
Thomson, W. H. Materialism and Modern Physiology of the Nervous System, 856.
Thorne, R. T. Diphtheria: its Natural History and Prevention, 130.
Trevert, E. Electric Railway Engineering, 855.
Tyndall, J. New Fragments, 127.
United States Commissoner of Education. Report, 1889, 559.
United States Fish Commission. Bulletin, 1889, 704.
United States Geological Survey. Report, 1888-'89, 704.
University Extension, Monthly, 420.
Wagner, R. von. Manual of Chemical Technology, 271.
Walker, S. F. How to Light a Colliery by Electricity, 707.

Books noticed:

Ward, H. M. The Oak, 556.
Waterdale. Fresh Light on the Dynamic Action and Ponderosity of Matter, 852.
Weismann, A. Essays upon Heredity, vol. ii, 854.
Whiteley, R. L. Chemical Calculations, 274.
Whymper, E. Travels among the Great Andes of the Equator, 273.
Winslow, A. Coal Deposits of Missouri, 131.

PAGE

Boots and Shoes, Manufacture of.* G. A. Rich..... 496
Botany, Beginnings in. B. D. Halsted..... 515
Brain, Temperature of the. (Misc.)..... 859
Brakemen, The Protection of. (Corr.) A. Morgan..... 698
Buddha, A, and its Meaning. (Misc.)..... 285
Burial Custom, Ancient Japanese. (Misc.)..... 567

C., L. H. Survival of Ancestral Traits. (Corr.)..... 123
Cadalso, A. Ruiz. Savage Superstitions. (Corr.)..... 123
Campbell, Charles W. Korean Mountains and Mountaineers..... 229
Cave Dwellings of Men.* W. H. Larrabee..... 27
Census, Eleventh. (Misc.)..... 715
Central American Monuments, Age of the. (Misc.)..... 861
Chapin, Henry Dwight, M. D. The Survival of the Unfit..... 182
Character, Human, Influence of Natural Surroundings on. (Misc.)..... 569
Chemical and Geographical Words, Changes in. F. A. Fernald..... 690
Chemung Geological Formation. (Misc.)..... 563
Childhood, American, from a Medical Standpoint. H. L. Taylor..... 721
Children, Scientific Observation of. (Misc.)..... 278
Chinese Characters and Hieroglyphics. (Misc.)..... 717
Churchill, Randolph. The Diamond Industry at Kimberley.*..... 455
Cigars, First, in Paris. (Misc.)..... 715
Color-vision, Defective, Remedies for. (Misc.)..... 862
Colors, The, of Water. C. Vogt..... 246
Common Sense wanted. (Editor's Table)..... 552
Contagions, Dealing with. (Misc.)..... 568
Cornwall, Tin Production of. (Misc.)..... 143
Correction, A. (Corr.) C. Paine..... 418
Crime, Natural Selection and. E. S. Morse..... 433
Criminality, Instinctive. Misc.)..... 140
Crothers, T. D. Specifics for the Cure of Inebriety..... 732

Dancing, The Evolution of.* L. J. Vance..... 739
Davies, N. E. Yorke. Proper Diet for Hot Weather..... 365
Death-week in Rural Russia. (Misc.)..... 717
Delaware Indian, The, as an Artist.* C. C. Abbott..... 586
Dendrites.* S. Meunier..... 84
Desert Fruit, A. Grant Allen..... 109
Diamond, Genesis of the. (Corr.) J. F. Lewis..... 412
" Industry at Kimberley, The.* R. Churchill..... 455
Diatoms, What are?* E. L. Gregory..... 200
Diet, Proper, for Hot Weather. N. E. Y. Davies..... 365
" " (Corr.) M. Miles..... 697
Diphtheria, Distribution of. (Misc.)..... 277

PAGE
Disease, Physiology and the Prevention of. J. M. Rice 308
"Down Below" People. (Misc.) 280
Du Bois-Reymond, Emil. Science and Fine Art 16
Dust and Fresh Air. T. P. Teale 238

Earthquake, Curious Effects of an. (Misc.) 138
Eddy, William A. Incalculable Accidents 666
Education, The "American Experiment" in. (Editor's Table) 267
Egypt, Agriculture in. (Misc.) 573
Egyptians, Natural Selection among. (Misc.) 715
Electric Light, New. (Misc.) 137
Embroidery by Machinery. (Misc.) 282

Families and Dwellings. C. D. Wright 474
Fernald, Frederik A. Changes in Chemical and Geographical Words 690
Fisheries, British. (Misc.) 286
Flame, Suspended Matter in. (Misc.) 142
Floras, American, Succession of. (Misc.) 429
Fog, Drops of. (Misc.) 139
Folk Lore, Evolution in. D. D. Wells 45
Food-vessels, Aluminum in. (Misc.) 569
Foot, The Prehensile, of East Indians.* F. Regnault 489
Forest Management, Objects of. (Misc.) 566
Fruit, Sulphuring Dried. (Misc.) 574
Funeral Customs in New Guinea. (Misc.) 716
Fungicides, Action of. (Misc.) 712
Fungus-nurseries, Wild Plants as. (Misc.) 572

Galileo Case, The Retreat of Theology in the. A. D. White 145
Galvani, Luigi, Sketch of. (With Portrait) 408
Gardening, Exotic, Development of. (Misc.) 716
Geographical Work of 1891. (Misc.) 860
Geography. A. D. White 446, 577
Geology, Why we should teach. A. S. Packard 73
Glass, Soldering Metals to. (Misc.) 861
Gold-cure, Historical Notes on the. H. C. Bolton 469
Gore, J. Ellard. "New" and Variable Stars 396
Greenland Vegetation, Origin of. (Misc.) 136
Gregory, Emily L. What are Diatoms?* 200
Gutta Percha, Sources of. (Misc.) 284

Halsted, Byron D. Beginnings in Botany 515
" " Pestiferous Plants 225
Healing Art, Limitations of the. H. Nothnagel 77
Heck, L. Two Rare Monkeys.* 389
Henderson, C. Hanford. Mica and the Mica Mines 652
Henry, Charles. Odors and the Sense of Smell 682
Herbert, Auberon, and Harold Wager. Bad Air and Bad Health 97
Homes, Some Indian, A Comparative Study of.* R. W. Shufeldt 798
Horses, Many-toed. (Misc.) 427

PAGE
Hudson, William H. Herbert Spencer and the Synthetic Philosophy 1
Huggins, William, Sketch of. (With Portrait)..... 260
Huxley, T. H. The Decline of Bibliolatry..... 594
Hypnotism as a Remedy. (Misc.)..... 564

Illegitimacy, Ratios of. (Misc.)..... 570
India-rubber Trees. (Misc.)..... 143
Indian Beauty, Types of. (Misc.)..... 863
Indian Trade, Influence of the. (Misc.)..... 282
Inebriety, Specifics for the Cure of. T. D. Crothers..... 732
Infectious Diseases: Causation and Immunity. G. M. Sternberg..... 616
Influenza, Weather and. (Misc.)..... 564
Intellectual Culture, Means of. (Editor's Table)..... 124

Janes, Lewis G. The Relation of Biology to Sociology..... 206
Jardin des Plantes, Origin of the. (Misc.)..... 713
Jastrow, Joseph. Further Study of Involuntary Movements.*..... 636

Kanjutis. (Misc.)..... 284
Kilmer, George L. First Actions of Wounded Soldiers..... 155
Kindergartens—Manual Training—Industrial Schools. Mrs. H. M. Plunkett. 375
Kingfisher. (Misc.)..... 286
Kingsley, J. S. The Marine Biological Laboratory*..... 604
Korean Mountains and Mountaineers. C. W. Campbell..... 229
Kropotkin, Prince. Recent Science..... 811

Lake Beaches. (Misc.)..... 431
" Waters, Temperature of. (Misc.)..... 427
Land, the Dry, The Waste and Gain of..... 403
Language and Brain Disease.* H. T. Pershing..... 775
Larrabee, W. H. Cave Dwellings of Men.*..... 27
Latitude, Oscillations in. (Misc.)..... 141
" Secular and Periodic Changes in. (Misc.)..... 862
Law, The, and the Doctors. (Editor's Table)..... 267
Leather-making.* G. A. Rich..... 339
Leaves, Primary Color of. (Misc.)..... 137
Lewis, Mrs. Julia F. Genesis of the Diamond. (Corr.)..... 412
Lightning, Curious Accident by. (Misc.)..... 863
Locusts, Our Destructive. (Misc.)..... 566
Lung-fish. (Misc.)..... 567

McMurrich, J. Playfair. More about the Penikese School. (Corr.)..... 412
McRae, Charles. Michael Servetus: Reformer, Physiologist, and Martyr.... 519
Magnifying Glasses in Antiquity. (Misc.)..... 716
Man, The Animal View of..... 256
Marine Biological Laboratory, The.* J. S. Kingsley..... 604
Masrium, The New Element. (Misc.)..... 861
Meteoric Iron. (Misc.)..... 140
Meteorological Discovery, A Chapter in. J. C. Adams..... 787
Meteorological Poet. (Misc.)..... 285

PAGE
Meteorology Five Centuries ago. (Misc.) 188
Meunier, Stanislas. Dendrites.* 84
Mica and the Mica Mines. C. H. Henderson 652
Miles, Manly. Energy as a Factor in Agriculture 87
" Proper Diet for Hot Weather. (Corr.) 697
Mind, Pace of. (Misc.) 279
Minerals and Fossils, Preservation of. (Misc.) 565
Monkeys, Two Rare.* L. Heck 389
Moral Endeavor. (Editor's Table) 700
Morgan, Appleton. The Protection of Brakemen. (Corr.) 698
" " Wanted—a Railway Court of Last Resort 212
Morse, Edward S. Natural Selection and Crime 433
Mortality and Morbidity by Professions. (Misc.) 139
Mosquitoes, Kerosene as a Preventive of. (Misc.) 863
Motherhood. (Editor's Table) 413
Movements, Involuntary, Further Study of.* J. Jastrow 636
Mud as a Building Material.* W. Simpson 762
Muir Glacier, Alaska. (Misc.) 711
Museums, Purposes and Arrangement of. (Misc.) 281
Musical Instruments, Saxon. (Misc.) 859
Mustagh Glaciers, Scenery of the. (Misc.) 563

Newberry, John S. The Ancient Civilizations of America 187
Nothnagel, Herrmann. The Limitations of the Healing Art 77

Obituary Notes. Andrew Crombie Ramsay, J. W. Ewald, Henry W. Bates, Wilhelm Junker, William Guy Peck, John Francis Williams, Sereno Watson 144
Charles Meymott Tidy 288
Hermann Franz Moritz Kopp 432
August Wilhelm Hoffmann, Henri Duveyrier 576
Ernest A. B. Mouchez, Hermann Burmeister 720
Olives and Olive Oil. (Misc.) 278
Overwork, Concerning. (Misc.) 573
Owl, Ways of the.* F. Bolles 313
Oxygen by the Brin Process. (Misc.) 718

Packard, Alpheus S. Why we should teach Geology 73
Paine, Charles. A Correction. (Corr.) 413
Parapee Palm. (Misc.) 565
Penikese School, More about the. (Corr.) J. P. McMurrich 412
Pershing, Howell T. Language and Brain Disease * 775
Philpott, Henry J. Almond Culture in California 328
Photography in Colors. (Misc.) 569
Physiology of Over-exertion. (Misc.) 574
Plants, Pestiferous. B. D. Halsted 225
Plunkett, Mrs. H. M. Kindergartens—Manual Training—Industrial Schools. 375
Political Progress. (Editor's Table) 698
Population, The Native and Foreign-born. C. D. Wright 756
Positivism in France. (Editor's Table) 701

PAGE
Potato Disease, Treatment of. (Misc.) ... 568
" Pulp, Roasted. (Misc.) ... 859
Prehistoric Lapidaries, Skill of. (Misc.) ... 572
Psychology, Experimental, at the World's Fair. (Misc.) ... 561
Puma, The. (Misc.) ... 282
Pyburn, George. Flowering Habit of the American Aloe. (Corr.) ... 413

Quail, Destruction of, and the Plague of Locusts. (Misc.) ... 719

Railway Court of Last Resort, Wanted—a. A. Morgan ... 212
Rain-drops, Size and Shape of. (Misc.) ... 860
Regnault, F. The Prehensile Foot of East Indians* ... 489
Reno, Conrad. The Wage-contract and Personal Liberty& ... 644
Rice, J. M., M. D. Physiology and the Prevention of Disease ... 308
Rich, George A. Leather-making* ... 339
" " " Manufacture of Boots and Shoes* ... 496
Riley, C. V. The Yucca Moth and Yucca Pollination* ... 171
Rochard, Jules. Tobacco and the Tobacco Habit ... 670
Rochester, N. Y., Scientific Work of. (Misc.) ... 858
Royal Society, The; or, Scientific Visionaries of the Seventeenth Century. M. D. Steele ... 531

Sargasso Sea, The. (Misc.) ... 862
Scenery, Historical and Interesting, Preservation of. (Misc.) ... 429
Schools, Boston Public, Moral, Manual, and Science Training in the. (Misc.) 711
" of New York State. (Misc.) ... 562
Science and Fine Art. E. Du Bois-Reymond ... 16
" Recent. Prince Kropotkin ... 811
" Teaching in Preparatory Schools. (Misc.) ... 571
" The Claims of. (Editor's Table) ... 844
Sea-coast Land, Destiny of. (Misc.) ... 279
Seeds, Fine Flower, Propagation of. (Misc.) ... 568
Sense of Smell, Odors and the. C. Henry ... 682
Servetus, Michael: Reformer, Physiologist, and Martyr. C. McRae ... 519
Shufeldt, R. W. A Comparative Study of some Indian Homes* ... 798
Shuswap Traits. (Misc.) ... 712
Silk-weaving Centers, French. (Misc.) ... 283
"Silver Thaw." (Misc.) ... 565
Simpson, W. Mud as a Building Material* ... 762
Slave Trade, Reason of the. (Misc.) ... 430
Snails of Mountain and Plain. (Misc.) ... 860
Snow Effects in the Pamirs. (Misc.) ... 280
Social Economy, State Intervention in. A. Leroy Beaulieu ... 463
Sociology, The Relation of Biology to. L. G. Janes ... 206
Species, Extermination of. (Misc.) ... 572
Spencer, Herbert. Veracity ... 482
" " and the Synthetic Philosophy. W. H. Hudson ... 1
Spring Two Hundred Years ago and now. (Misc.) ... 574
Star Spectra, Characteristics of. (Misc.) ... 430
Starr, Frederick. Anthropological Work in America* ... 289

PAGE
Starr, Frederick. Anthropological Work in Europe*..... 54
Stars, "New" and Variable. J. E. Gore..... 396
Steele, Miss Mary Davies. The Royal Society; or, Scientific Visionaries of the Seventeenth Century..... 531
Sternberg, George M., M. D. Infectious Diseases: Causation and Immunity. 616
Stone Age, New, in Iceland. (Misc.)..... 716
Superstitions, Savage. (Corr.) A. R. Cadalso..... 123
Survival of Ancestral Traits. (Corr.) L. H. C..... 123
" The, of the Unfit. H. D. Chapin..... 182
Swedish Wood and Iron. (Misc.)..... 141

Taylor, Henry Ling. American Childhood from a Medical Standpoint..... 721
Tea Plant, American. (Misc.)..... 426
Teale, T. Pridgin. Dust and Fresh Air..... 238
Technical School at St. Etienne, France. (Misc.)..... 281
Testimony, Human, Value of. (Misc.)..... 428
Theology, Progressive. (Editor's Table)..... 551
Timber-testing. (Misc.)..... 429
Title-pages, Early. (Misc.)..... 137
Trees and Extreme Temperatures. (Misc.)..... 714
" Venerable. (Misc.)..... 138
Typhoid Fever and Sewage in Drinking-water. (Misc.)..... 574

Vance, Lee J. The Evolution of Dancing*..... 739
Veracity. H. Spencer..... 482
Vlachs of Turkey. (Misc.)..... 142
Vogt, Carl. The Colors of Water..... 246
Volta, Alessandro, Sketch of. (With Portrait)..... 117

Wage-contract, The, and Personal Liberty. C. Reno..... 644
Wager, Harold, and Auberon Herbert. Bad Air and Bad Health..... 97
Warming and Ventilation of Dwellings*..... 831
Watch-making, Swiss. (Misc.)..... 283
Weeds, Eastern and Western. (Misc.)..... 568
Wells, David Dwight. Evolution in Folk Lore..... 45
Wheat-raising, Possibilities of. (Misc.)..... 277
Wheelbarrow, Antiquity of the. (Misc.)..... 714
White, Andrew Dickson. From Magic to Chemistry and Physics.....
" " " Geography.....446, 577
" " " The Retreat of Theology in the Galileo Case..... 145
Winchell, Alexander, Sketch of. (With Portrait)..... 837
Wounded Soldiers, First Actions of. G. L. Kilmer..... 155
Wright, Carroll D. Families and Dwellings..... 475
" " " The Native and Foreign-born Population..... 756

Yucca Moth, The, and Yucca Pollination.* C. V. Riley..... 171

Zebra's Stripes. (Misc.)..... 567

END OF VOL. XLI.

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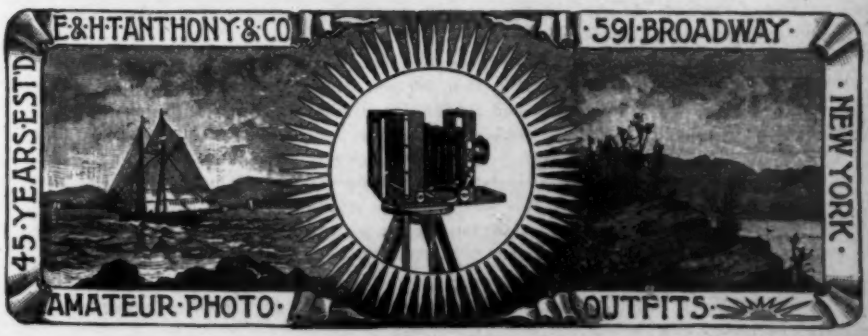

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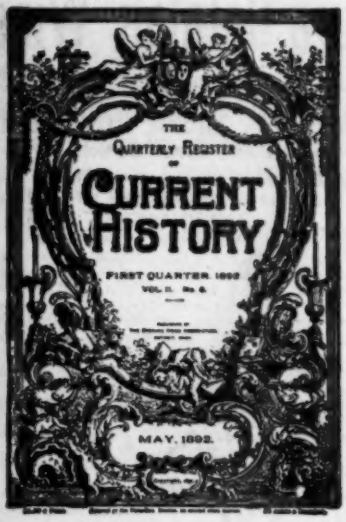

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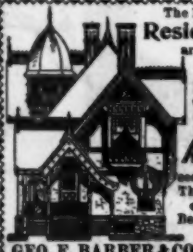

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THE POPULAR SCIENCE MONTHLY.

OCTOBER, 1892.

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CONTENTS.

	PAGE
I. American Childhood from a Medical Standpoint. By HENRY LING TAYLOR, M. D.	721
II. Specifics for the Cure of Inebriety. By T. D. CROTHERS, M. D.	732
III. The Evolution of Dancing. By LEE J. VANCE. (Illustrated.)	739
IV. Our Native and Foreign-born Population. By CARROLL D. WRIGHT, A. M. Lessons from the Census. VIII	756
V. Mud as a Building Material. By WM. SIMPSON, R. I. (Illus.)	762
VI. Language and Brain Disease. By H. T. PERSHING, M. D. (Illus.)	775
VII. A Chapter in Meteorological Discovery. By JOHN C. ADAMS	787
VIII. A Comparative Study of some Indian Homes. By Dr. R. W. SHUFELDT. (Illustrated.)	798
IX. Recent Science. By PRINCE KROPOTKIN	811
X. Warming and Ventilation of Private Dwellings. (Illustrated.)	831
XI. Sketch of Alexander Winchell. (With Portrait.)	837
XII. Editor's Table: The Claims of Science. — The Rochester Meeting of the American Association	844
XIII. Literary Notices	849
XIV. Popular Miscellany	858
XV. Notes	863
XVI. Index to Vol. XLI	865

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ASSETS.

Real Estate, including all Office Buildings and property purchased under foreclosure	$12,428,247 15	
Stocks and Bonds owned	77,647,663 40	
Bonds and Mortgages	21,406,233 56	
Loans secured by collaterals (market value of Securities held as collateral, $5,872,357)	4,551,000 00	
Premium Loans on existing Policies (the Reserve on these Policies, included in Liabilities, amounts to over $2,000,000)	521,700 28	
Cash in Office and in Banks and Trust Companies	6,070,942 27	
Interest and Rents due and accrued	563,037 81	
Net amount of uncollected and deferred Premiums	2,756,466 34	
TOTAL ASSETS		**$125,947,290 81**

LIABILITIES.

Reserve, or Value of outstanding Policies, at Actuaries' 4 per cent, as per Certificate of New York State Insurance Department	$108,439,235 00	
Special Reserve on Annuities, in excess of State Standard	988,921 00	
Approved Losses in course of payment	658,272 66	
Reported Losses awaiting proof, etc.	544,895 01	
Matured Endowments due and unpaid (claims not presented)	47,993 71	
Annuities due and unpaid (claims not presented)	28,060 68	
Premiums paid in advance	52,696 94	
Trust Deposit, held for account of beneficiaries under terms of Policies	46,192 50	
Total Liabilities		**$110,806,267 50**
Surplus, being the same amount which will be shown to be the Company's Surplus by the Annual Report of the New York State Insurance Department as of December 1, 1891		**$15,141,023 31**
Estimated Surplus accrued on Tontine Policies	$9,757,121 00	
" " " " all other "	5,383,902 31	—$15,141,023 31

INCOME.

Premiums received on Insurance Policies	$23,554,996 97	
Premiums paid by Dividends and by Surrender Values	1,430 607 00	
Premiums received for Annuities	1,304,120 81	
	$26,289,724 78	
Deduct amount paid for re-insurance	33,449 38	
Total Premium Income		$26,256,275 40
Interest and Rents received		5,548,727 08
Trust Deposit received and held for account of beneficiaries under the terms of Policies		49,192 50
Total Income		**$31,854,194 98**

DISBURSEMENTS.

Losses paid	$6,087,620 70	
Endowments matured and discounted, paid	1,066,795 11	
Annuities paid	1,371,634 26	
Dividends paid	1,260,340 74	
Paid for Purchased Policies	1,710,208 36	
Surrender Values applied as Premiums	706,081 67	
Purchased Reversions	465,810 04	
Installment paid on Trust Deposit	3,000 00	
Total Amount paid to Policy-holders	$12,671,490 88	
Commissions and Brokerages to Agents	3,918,142 69	
Agency Expenses	931,810 66	
Physicians' Fees, Advertising, Stationery, and Printing	618,803 62	
Salaries	500,578 18	
Law and Office Expenses, Rents, and Repairs and Care of Real Estate	533,113 27	
Taxes in the State of New York and other States	284,150 60	
Total Disbursements		**$19,458,089 90**

NOTE AS TO SURPLUS.

The Surplus on January 1, 1892, according to the valuations of Securities made by the Insurance Department in its recent examination, and according to the State Standard of Policy Reserve, was		$17,049,320 13
But the Trustees have deemed it for the best interests of the policy-holders to apply a part thereof in the reduction of values of several Office Buildings, such reduction amounting to	$919,375 82	
The Trustees have also deemed it best to increase the Reserve held for annuitants above the sum fixed by the State standard of valuation, such excess being	988,921 00	—$1,908,296 82
		$15,141,023 31

Number of Policies issued during 1891, 52,746.
Total number of Policies in force Jan. 1, 1892, 193,452.

New Insurance, $152,664,982.
Amount at Risk, $614,824,713.

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